MERCURY
MerCruiser

SERVICE MANUAL

Number 14

Sterndrive Units
Alpha One
Generation II

MAIN MENU

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MerCruiser #14 Sterndrive Units

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IMPORTANT INFORMATION

Section 1A - General Information

1 A

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How To Use This Manual

This Manual is divided into sections which represent major components and systems.

Some sections are further divided into parts which more fully describe the component.

Sections and parts are listed at the front of this manual.

Page Numbering

Two number groups appear at the bottom of each page. Following is an example and description.

a - Section Number
b - Section Part
c - Page Number
d - Manual Part Number
e - Revision Number
f - Month Printed
g - Year Printed

Introduction

This comprehensive overhaul and repair manual is designed as a service guide for the Mercury MerCruiser models previously listed. It provides specific information, including procedures for disassembly, inspection, assembly and adjustment, to enable dealers and service mechanics to repair these products.

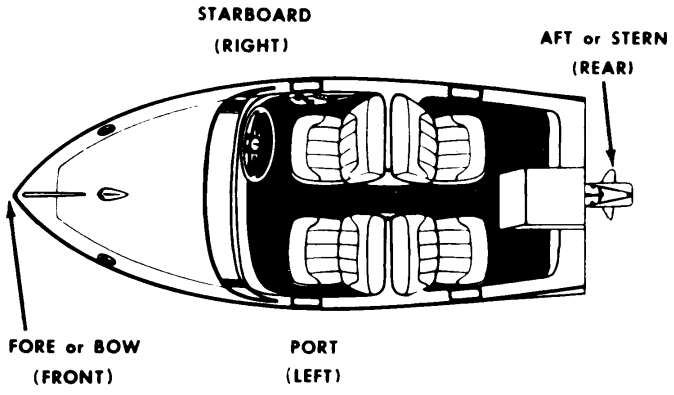
Before attempting repairs, it is suggested that the procedure be read to gain knowledge of the methods and tools used and the cautions and warnings required for safety.

Special Product Information

During production of these models, special product improvements and changes have been made to increase product reliability and performance. Such changes to a sterndrive assembly component(s) are covered in the “Special Information” portion of the appropriate sterndrive assembly section. (Refer to the section “Index”.) Serial number breaks are provided, where applicable, for ease of identification.

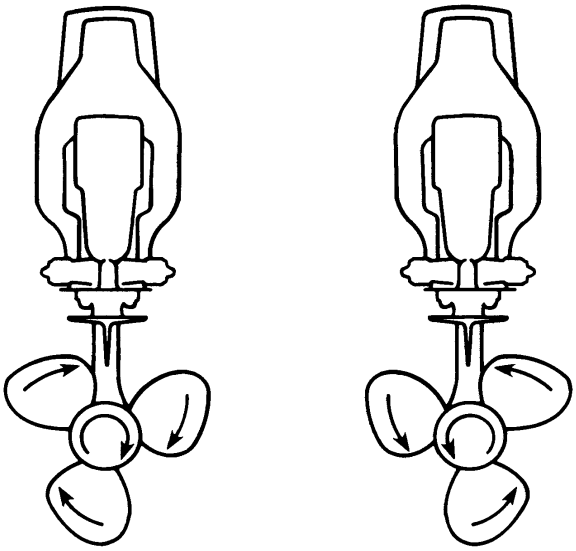
Directional References

Front of boat is bow; rear is stern. Starboard side is right side; port side is left side. In this service manual, all directional references are given as they appear when viewing boat from stern, looking toward bow.



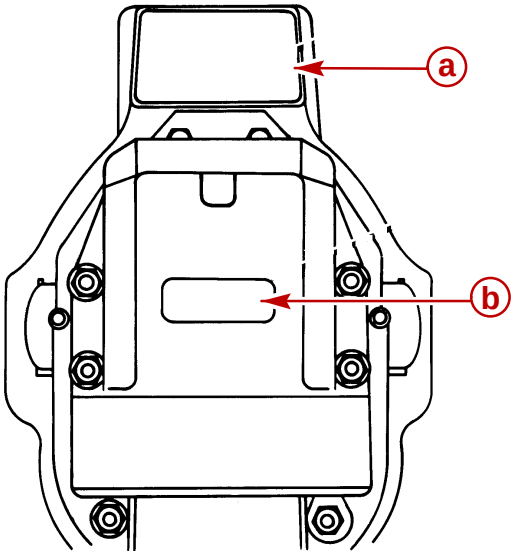
Propeller Rotation

Propeller rotation for sterndrive can be right hand or left hand rotation as viewed from the aft end of the propeller.



Right Hand Rotation **Left Hand Rotation**

Serial Number Locations and Engine Designation Decal



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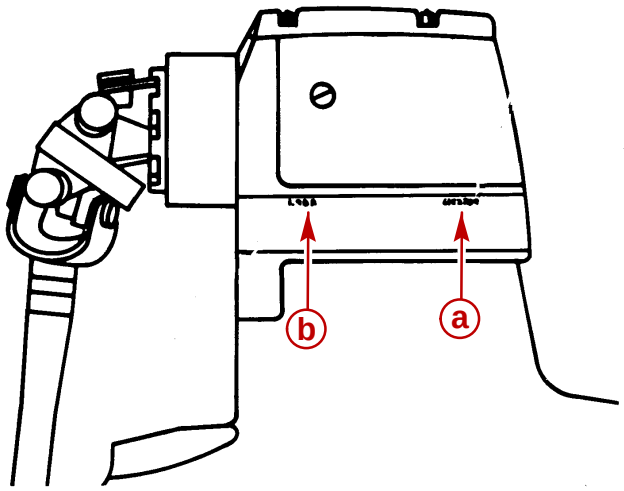
a - Transom Assembly Serial Number
b - Engine Designation Decal

Sterndrive Unit Serial Number Location



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Sterndrive Unit Serial Number Location - Port Decal

(Also Located Under Decal On Housing)

a - Sterndrive Unit Serial Number
b - Sterndrive Unit Gear Ratio

Decal Application

Decal Removal

1. Mark decal location before removal to assure proper alignment of new decal.
2. Carefully soften decal and decal adhesive with a heat gun or heat blower while removing old decal.
3. Clean decal contact area with a 1:1 mixture of isopropyl alcohol and water.
4. Thoroughly dry decal contact area and check for a completely cleaned surface.

Instructions for “Wet” Application

NOTE: *The following decal installation instructions are provided for a “Wet” installation.* ***All*** *decals should be applied wet.*

TOOLS REQUIRED

1. Plastic Squeegee*
2. Stick Pin
3. Dish Washing **Liquid/Detergent without ammonia**** “Joy” and “Drift” are compatible for this process.

* Automotive Body Filler Squeegee

** Do not use a soap that contains petroleum based solvents.

SERVICE TIP: Placement of decals using the "Wet" application will allow time to position decal. Read entire installation instructions on this technique before proceeding.

TEMPERATURE

IMPORTANT: Installation of vinyl decals should not be attempted while in direct sunlight. Air and surface temperature should be between 60°F (15°C) and 100°F (38°C) for best application.

SURFACE PREPARATION

IMPORTANT: Do not use a soap or any petroleum based solvents to clean application surface.

Clean entire application surface with mild dish washing liquid and water. Rinse surface thoroughly with clean water.

DECAL APPLICATION

1. Mix $^{1}/_{2}$ ounce (16 ml) of dish washing liquid in one gallon (4 l) of cool water to use as wetting solution.

NOTE: *Leave protective masking, if present, on the face of decal until final steps of decal installation. This will ensure that the vinyl decal keeps its shape during installation.*

2. Place the decal face down on a clean work surface and remove the paper backing from "adhesive side" of decal.
3. Using a spray bottle, flood the entire "adhesive side" of the decal with the pre-mixed wetting solution.
4. Flood area where the decal will be positioned with wetting solution.
5. Position pre-wetted decal on wetted surface and slide into position.
6. Starting at the center of the decal, "**lightly**" squeegee out the air bubbles and wetting solution with overlapping strokes to the outer edge of the decal. Continue going over the decal surface until all wrinkles are gone and adhesive bonds to the cowl surface.
7. Wipe decal surface with soft paper towel or cloth.
8. **Wait 10 - 15 minutes.**
9. Starting at one corner, "carefully and slowly" pull the masking off the decal surface at a 180° angle.

NOTE: *To remove any remaining bubbles, pierce the decal at one end of the bubble with stick pin and press out the entrapped air or wetting solution with your thumb (moving toward the puncture).*

Painting Procedures

Cleaning & Painting Aluminum Propellers & Gear Housings

⚠ WARNING

Avoid serious injury from flying debris. Avoid serious injury from airborne particles. Use eye and breathing protection with proper ventilation.

PROPELLERS

1. Sand the entire area to be painted with 3M 120 Regalite Polycut or coarse Scotch-Brite, disc or belts.
2. Feather edges of all broken paint edges. Try not to sand through the primer.
3. Clean the surface to be painted using PPG Industries DX330 Wax and Grease Remover or equivalent (Xylene or M.E.K.).
4. If bare metal has been exposed, use Quicksilver's Light Gray Primer.
5. Allow a minimum of 1 hour dry time and no more than 1 week before applying the finish coat.
6. Apply the finish coat using Quicksilver's EDP Propeller Black.

GEAR HOUSINGS

The following procedure should be used in refinishing gear housings. This procedure will provide the most durable paint system available in the field. The materials recommended are of high quality and approximate marine requirements. The following procedure will provide a repaint job that compares with a properly applied factory paint finish. It is recommended that the listed materials be purchased from a local Ditzler Automotive Finish Supply Outlet. The minimum package quantity of each material shown is sufficient to refinish several gear housings.

Procedure:

1. Wash gear housing with a muriatic acid base cleaner to remove any type of marine growth, and rinse with water, if necessary.
2. Wash gear housing with soap and water, then rinse.
3. Sand blistered area with 3M 180 grit sandpaper or P180 Gold Film Disc to remove paint blisters only. Feather edge all broken paint edges.
4. Clean gear housing thoroughly with (DX-330) wax and grease remover.
5. Spot repair surfaces where bare metal is exposed with (DX-503) alodine treatment.

IMPORTANT: Do not use any type of aerosol spray paints as the paint will not properly adhere to the surface nor will the coating be sufficiently thick to resist future paint blistering.

6. Mix epoxy chromate primer (DP-40) with equal part catalyst (DP-401) per manufacturers instructions, allowing proper induction period for permeation of the epoxy primer and catalyst.

IMPORTANT: Do not paint sacrificial zinc trim tab or zinc anode.

7. Cut out a cardboard "plug" for trim pump pocket to keep paint off of mating surface to maintain good continuity circuitry between trim tab and gear housing.

8. Allow a minimum of one hour drying time and no more than one week before top coating assemblies.
9. Use Ditzler Urethane DU9000 for Mercury Black and DU33414M for Sea Ray White. Catalyze the colors with Ditzler DU5 catalyst mixed 1:1 ratio. Reduce with solvents per Ditzler label.

⚠ CAUTION

Be sure to comply with instructions on the label for ventilation and respirators. Using a spray gun, apply one half to one mil even thickness. Let dry, flash off for five minutes and apply another even coat of one half to one mil film thickness. This urethane paint will dry to the touch in a matter of hours, but will remain sensitive to scratches and abrasions for a few days.

10. The type of spray gun used will determine the proper reduction ratio of the paint.

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IMPORTANT INFORMATION

Section 1B - Maintenance

1 B

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Maintenance Schedules

Maintenance Intervals

Maintenance intervals and the tasks to be performed, as shown in this current schedule, or as found in a previously printed schedules, are generally based on an average boating application and environment. However, individual operating habits and personal maintenance preferences can have an impact on the suggested intervals. In consideration of these factors, Mercury MerCruiser has adjusted some maintenance intervals and corresponding tasks to be performed. In some cases, this may allow for more individual tasks to be performed in a single visit to the serving dealer, rather than multiple visits. Therefore, it is very important that the boat owner and servicing dealer discuss the current Maintenance Schedule and develop appropriate maintenance intervals to coincide with the individual operating habits, environment, and maintenance requirements.

⚠ CAUTION

Always disconnect battery cables from battery BEFORE working around electrical systems components to prevent injury to yourself and damage to electrical system should a wire be accidentally shorted.

Gas Sterndrive

Routine Maintenance *

	Each Day Start	Each Day End	Weekly	Every Two Months
Check crankcase oil (interval can be extended based on experience).				
	●			
If operating in salt, brackish or polluted waters, flush cooling system after each use.				
		●		
Check drive unit oil level, trim pump oil level and power steering pump fluid level.				
			●	
Check water pickups for debris or marine growth. Check water strainer and clean. Check coolant level.				
			●	
Inspect drive unit anodes and replace if 50 percent eroded.				
			●	
Inspect fuel pump sight tube and have pump replaced if fuel is present.				
			●	
Check battery connections and fluid level.				
				●
Lubricate propeller shaft and the retorque nut (if operating in only freshwater, this maintenance may be extended to every four months).				
				●
Operating in Saltwater Only: treat engine surface with corrosion guard.				
				●

* Only perform maintenance which applies to your particular power package.

Gas Sterndrive (Continued)

Scheduled Maintenance *

Annually	Every 100 Hours or Annually◆	Every 200 Hours or 3 Years◆	Every 300 Hours or 3 Years◆	Every 2 Years	Every 5 Years
Touch-up paint power package and spray with corrosion guard.					
●					
Change crankcase oil and filter.					
	●				
Change drive unit oil and retorque connection of gimbal ring to steering shaft.					
	●				
Replace fuel filter.					
	●				
Check steering system and remote control for loose, missing or damaged parts. Lubricate cables and linkages.					
	●				
Inspect U-joints, splines and bellows. Check clamps. Check engine alignment. Lubricate U-joint splines.					
	●				
Lubricate gimbal bearing and engine coupler.					
	●8				
Check continuity circuit for loose or damaged connections. Test MerCathode® unit output on Bravo models.					
	●				
Retorque engine mounts.					
	●				
Check spark plugs, wires, distributor cap and ignition timing. Check and adjust idle speed.					
	●				
Clean flame arrestor and crankcase ventilation hoses. Replace PCV valve.					
	●				
Check electrical system for loose, damaged or corroded fasteners.					
	●				
Inspect condition and tension of belts.					
	●				
Check cooling system and exhaust system hose clamps for tightness. Inspect both systems for damage or leaks.					
	●				
Disassemble and inspect seawater pump and replace worn components.					
	●				
Clean seawater section of closed cooling system. Clean, inspect and test pressure cap.					
	●				
Replace coolant.					
				♠	●

* Only perform maintenance which applies to your particular power package.

◆ Whichever occurs first.

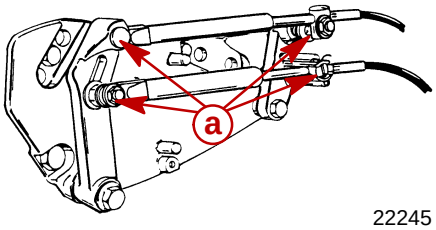
8 Lubricate engine coupler every 50 hours if operated at idle for prolonged periods of time.

♠ Interval will be reduced if not using extended life coolant.

Quicksilver Maintenance Products

We recommend the use of Quicksilver Maintenance Products where specified.

Lubricating Shift Cable Pivot Points



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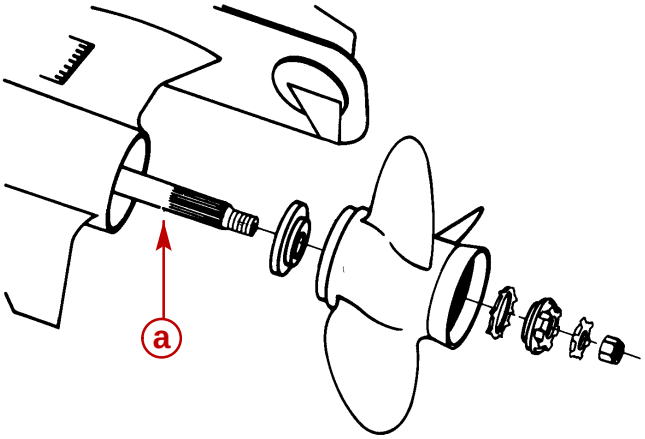
a - SAE 20 Or 30 Engine Oil

Lubricating Propeller Shaft



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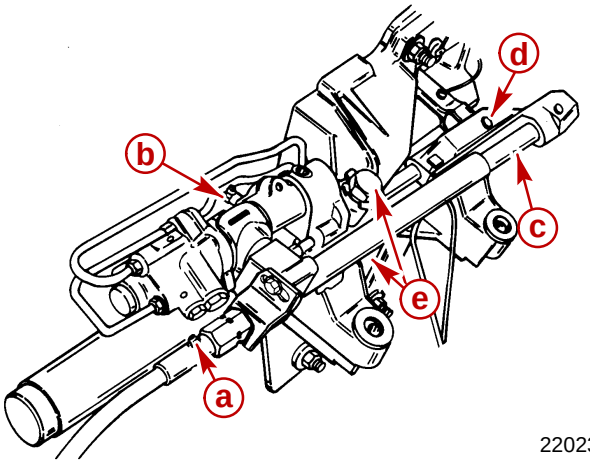
a - Special Lubricant 101, 2-4-C Marine Lubricant With Teflon Or Perfect Seal With Teflon (Listed In Order Of Effectiveness)

Lubricating Steering System

⚠ WARNING

Transom end of steering cable MUST BE fully retracted into cable housing when lubricating cable. If cable is lubricated while extended, hydraulic lock of cable could occur.

Power Steering Models



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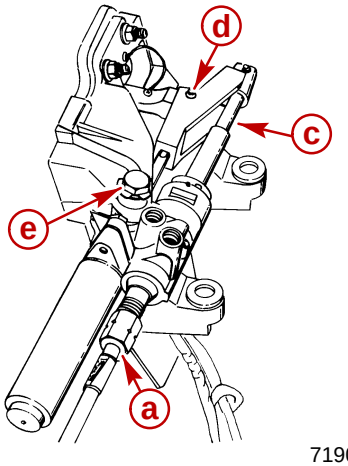
Earlier Style Control Valve



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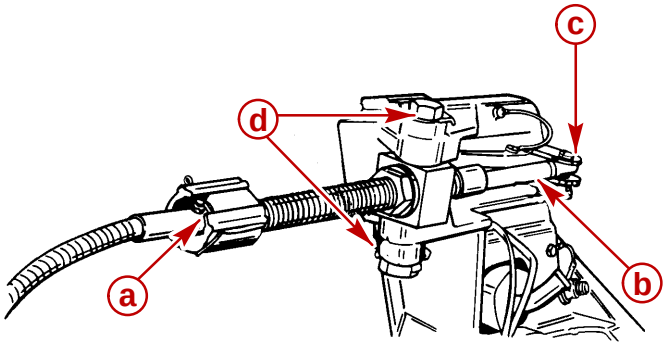
Later Style Control Valve

- **a** - Steering Cable Grease Fitting - 2-4-C Marine Lubricant With Teflon
- **b** - Control Valve Grease Fitting - 2-4-C Marine Lubricant With Teflon
- **c** - Steering Cable End - Special Lubricant 101
- **d** - Pivot Point - Sae 20 Or 30 Engine Oil
- **e** - Pivot Bolts - Special Lubricant 101

Manual Steering Models



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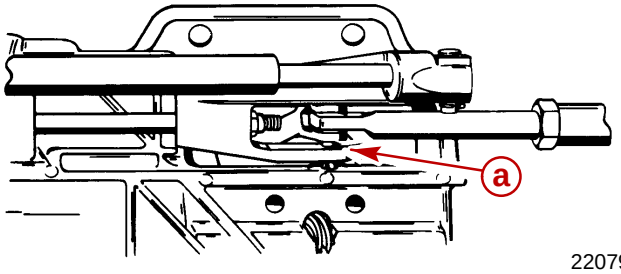
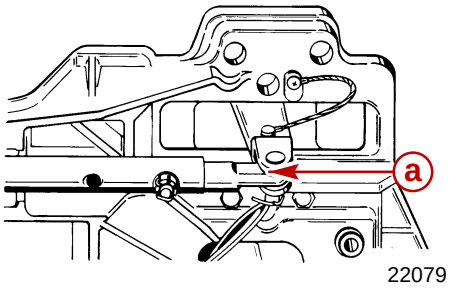
- **a** - Steering Cable Grease Fitting - 2-4-C Marine Lubricant With Teflon
- **b** - Steering - Cable End And Exposed Portion - Special Lubricant 101
- **c** - Pivot Points - SAE 20 Or 30 Engine Oil
- **d** - Pivot Bolts - Special Lubricant 101

Lubricating Tie Bar Pivot Points

Models With Control Valve Mounted On Starboard Transom Assembly



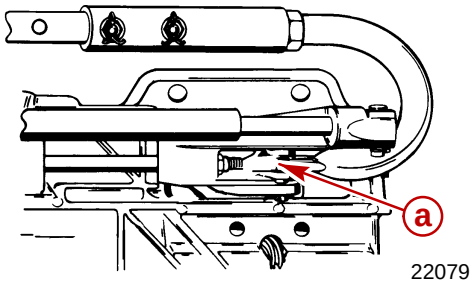
Starboard Engine



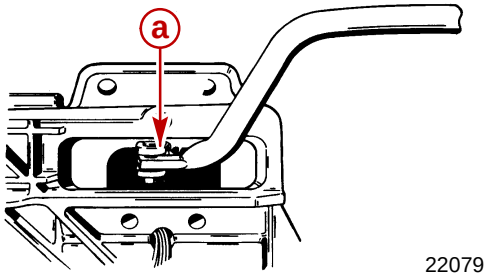
Port Engine

a - SAE 20 Or 30 Engine Oil

Models With Control Valve Mounted On Port Transom Assembly



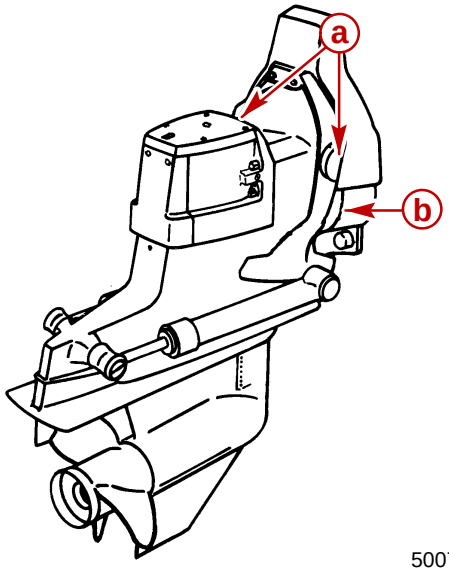
Port Engine



Starboard Engine

a - SAE 20 Or 30 Engine Oil

Lubricating Transom and Gimbal Assembly ,Hinge Pins and Gimbal Bearing



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a - Hinge Pins (One On Each Side)
b - Gimbal Bearing Grease Fitting - Quicksilver U-Joint And Gimbal Bearing Grease

Checking and Adding Sterndrive Oil

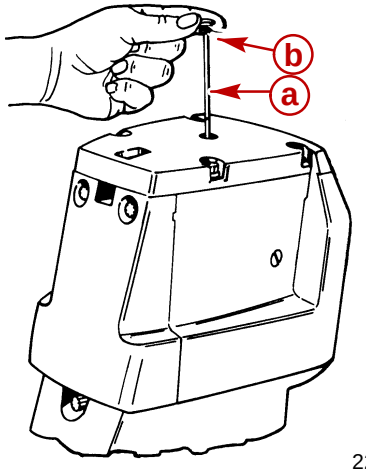
IMPORTANT: Position sterndrive unit in DOWN/IN position so that anti-ventilation plate is level.

Models Without Drive Unit Gear Lube Monitor

⚠ CAUTION

On models with Gear Lube Monitor, that have a dipstick in driveshaft housing cover: DO NOT REMOVE DIPSTICK - DO NOT CHECK OIL LEVEL WITH DIPSTICK. Removal of dipstick results in oil level raising/overfill condition, which can cause oil seal damage; if left open, drive unit will overflow.

1. Check oil level - oil should come up to line on dipstick. If oil is at proper level, reinstall oil dipstick and sealing washer. If oil is low, proceed to Step 2.



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a - Oil Dipstick
b - Sealing Washer (On Threads)

⚠ CAUTION

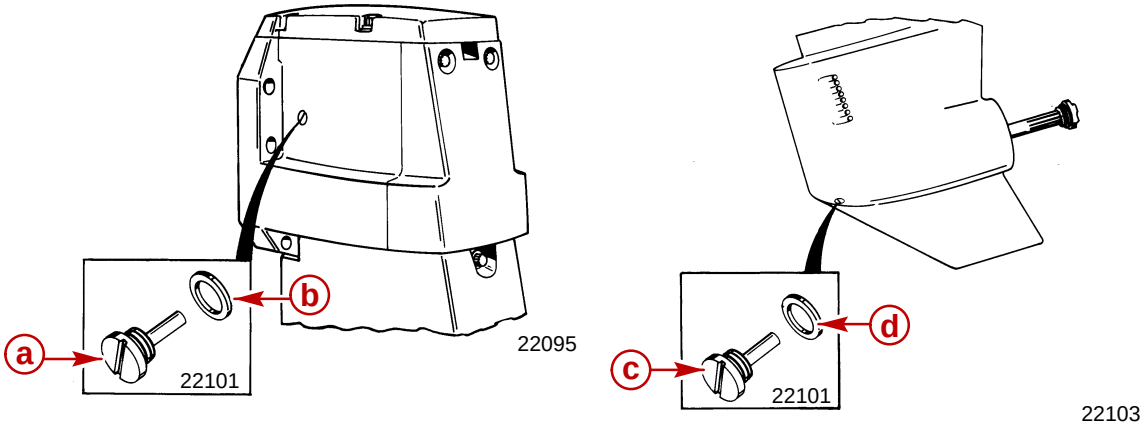
DO NOT attempt to fill drive unit through oil vent hole, as air will be trapped in drive unit and unit will be damaged from lack of lubrication.

⚠ CAUTION

If more than 2 fl. oz. (59 ml) of oil is required to fill drive unit, an oil leak may exist. Find and correct cause of leak before unit is placed in operation.

2. If oil level is low, reinstall dipstick; then, remove oil fill/drain plug and insert lubricant pump into oil fill/drain hole.

3. Remove oil vent plug; then, fill drive unit (through oil fill/drain unit hole) with oil until an air-free stream of oil flows out of oil vent hole.



a - Oil Vent Plug
b - Sealing Washer Or O-ring
c - Oil Fill/Drain Plug
d - Sealing Washer Or O-ring

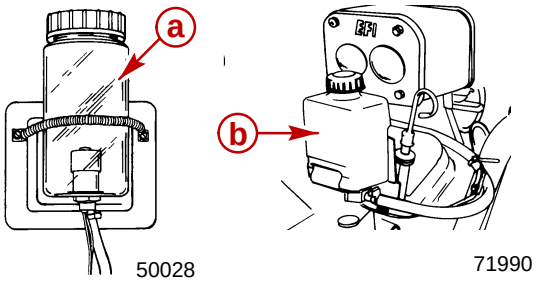
4. Without removing lubricant pump from fill/drain hole, reinstall vent plug and sealing washer (or O-ring if equipped). Torque to 40 lb-in. (4 Nm).
5. Remove lubricant pump and quickly reinstall fill/drain plug and sealing washer (or O-ring if equipped). Torque to 40 lb-in. (4 Nm).
6. Recheck oil level, using dipstick.

Models With Gear Lube Monitor

IMPORTANT: Position drive unit in DOWN/IN position, verify that the anti-ventilation plate is level.

NOTE: *Drive unit oil level is checked at gear lube monitor.*

IMPORTANT: Oil level in gear lube monitor will rise and fall during drive operation; always check oil level when drive is cool and engine is shut down.



a - Round Gear Lube Monitor
b - Square Gear Lube Monitor

1. Fill gear lube monitor to “FULL” line on decal. Lubricate O-ring seal on gear lube monitor neck with sterndrive oil, to ensure ease of installing and removing cap, and install gear lube monitor cap. Do not overtighten cap - 1/4 turn, after cap contacts seal, is sufficient.

⚠ CAUTION

On models with Gear Lube Monitor, that have a dipstick in driveshaft housing cover: DO NOT REMOVE DIPSTICK - DO NOT CHECK OIL LEVEL WITH DIPSTICK. Removal of dipstick results in oil level raising/overfill condition, which can cause oil seal damage; if left open, drive unit will overflow.

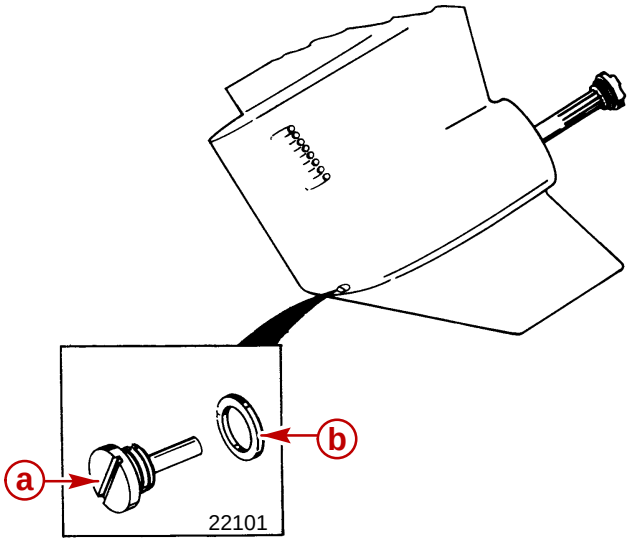
2. Check oil level in gear lube monitor.

Checking Lubricant for Water

Periodically inspect lubricant for water to ensure that drive unit seals are not leaking.

MODELS WITHOUT DRIVE UNIT GEAR LUBE MONITOR

1. Trim drive unit to the full Trim UP/OUT position.
2. Remove fill/drain plug to take a sample of lubricant. If water is observed or if lubricant appears discolored, drive unit is leaking and must be resealed.



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a - Fill/Drain Plug
b - Sealing Washer Or O-ring

3. Reinstall fill/drain plug. Torque to 40 lb-in. (4.0 Nm).

MODELS WITH GEAR LUBE MONITOR

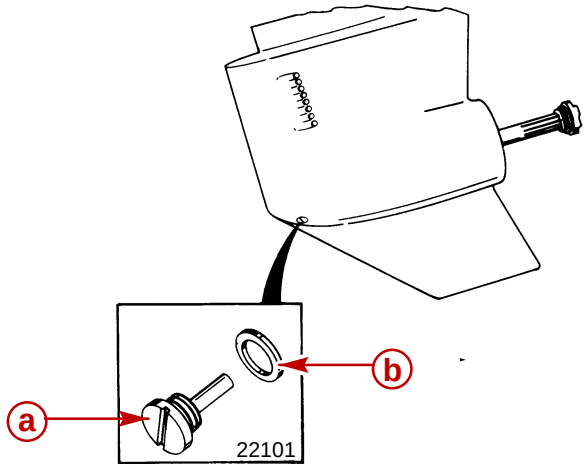
Check for water at bottom of gear lube monitor, and/or if oil appears discolored, a water leak is indicated somewhere in the drive unit, and drive unit must be resealed.

⚠ CAUTION

If more than 2 fl. oz. (59ml) of Quicksilver High Performance Gear Lube is required to fill gear lube monitor, a seal may be leaking. Find and correct cause of leak before unit is placed in operation.

IMPORTANT: If drive unit has set overnight or longer, check for water in drive unit, as follows:

1. Trim drive unit to full Trim UP/OUT position.



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a - Oil Fill/Drain Plug
b - Sealing Washer or O-ring

2. Remove fill/drain plug to sample lubricant. If water runs out, and/or if lubricant appears discolored, drive unit is leaking and **must** be resealed.
3. Reinstall fill/drain plug. Torque to 40 lb-in. (4 Nm).

Changing Lubricant

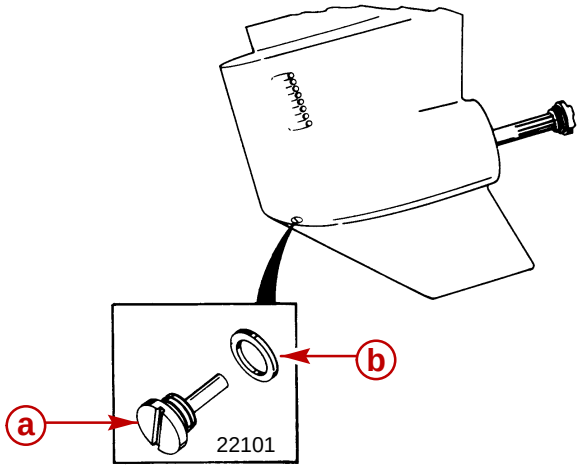
⚠ CAUTION

If any water drains from fill/drain hole, or if oil color appears discolored, a leak in drive unit may exist. Find and correct cause of leak before placing unit back in operatIon.

⚠ CAUTION

DO NOT attempt to fill drive unit through oil vent holes, as air will be trapped in drive unit and unit will be damaged from lack of lubrication.

1. Trim drive unit to full Trim UP/OUT position.



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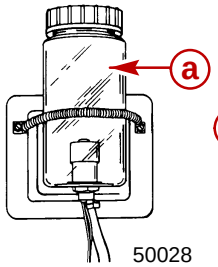
a - Oil Fill/Drain Plug
b - Sealing Washer or O-ring

2. **Models with drive unit Gear Lube Monitor, only:** remove drive unit gear lube monitor from bracket, remove cap, empty contents of gear lube monitor into suitable container and discard. Clean gear lube monitor thoroughly, and return gear lube monitor to bracket. Do not refill at this time. Check condition of hose and hose connections - replace as necessary.



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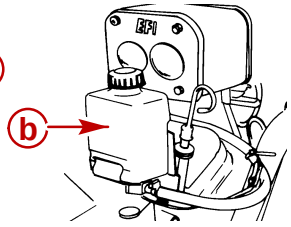

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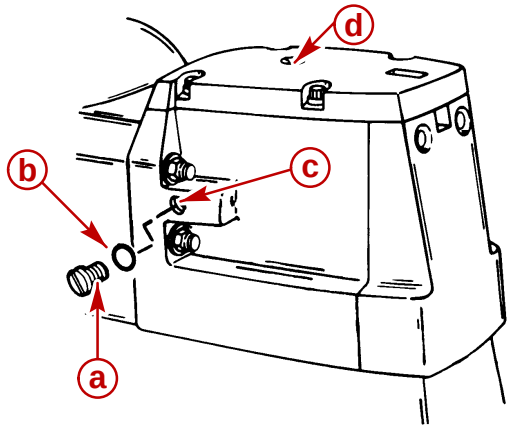
a - Round Gear Lube Monitor
b - Square Gear Lube Monitor

3. **All models:** remove drive unit vent plug, and fill/drain plug; allow lubricant to drain completely.

4. Trim drive unit to full DOWN/IN position, with anti-ventilation plate level, to complete draining process.



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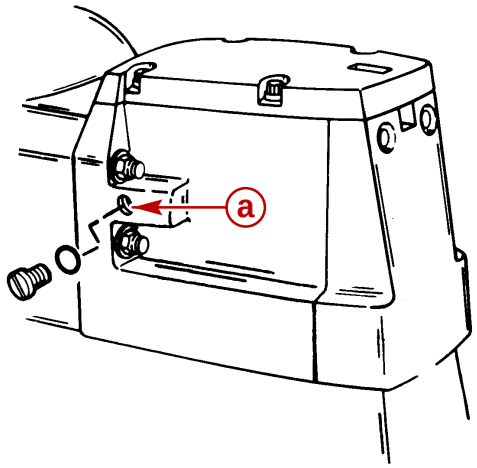
a - Oil Vent Plug
b - Sealing Washer Or O-ring
c - Vent Hole
d - Dipstick

5. Using lubricant pump, fill drive unit through fill/drain hole with lubricant until oil is even with bottom edge of vent hole.
6. Without removing lubricant pump from fill/drain hole, reinstall oil vent plug and sealing washer.
   a. **Non-Gear Lube Monitor Models:** torque oil vent plug to 40 lb-in. (4 Nm).
   b. **Gear Lube Monitor Models:** tighten oil vent plug snugly; do not torque at this time.
7. **All models:** remove lubricant pump and quickly reinstall fill/drain plug and sealing washer. Torque to 40 lb-in. (4 Nm).

Models with Gear Lube Monitor:

8. Remove oil vent plug and sealing washer (with drive unit in full DOWN/IN position).
9. Fill gear lube monitor bottle with Quicksilver High-Performance Gear Lube. When oil starts to run out the vent hole (gear lube hose between drive unit and gear lube bottle becomes filled), reinsert vent plug. Torque to 40 lb-in. (4 Nm).
10. Fill gear lube monitor to “FULL” line on decal. Lubricate O-ring seal on gear lube monitor neck with sterndrive oil, to ensure ease of installing and removing cap. Install gear lube monitor cap. Do not overtighten.

11. **All models:** recheck oil level after first use.



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a - Vent Hole

General Maintenance

Maintaining Power Package Exterior Surfaces

Entire Power Package should be sprayed at recommended intervals with Quicksilver Corrosion Guard. Follow instructions on can for proper application.

At least once each year, entire Power Package should be cleaned and external surfaces that have become bare should be repainted with Quicksilver Primer and Spray Paint.

Steering Head and Remote Control Maintenance

Lubricate steering head and remote control with 2-4-C Marine Lubricant with Teflon. Inspect steering head and remote control for ease of operation.

Checking Quicksilver MerCathode System

If boat is equipped with a Quicksilver MerCathode System, system should be tested to ensure that it is providing adequate output to protect underwater metal parts on boat. Test should be made where boat is moored, using Quicksilver Reference Electrode and Test Meter.Refer to section 7.

Maintaining Anodic Trim Tab or Plate

Each sterndrive unit is equipped with a sacrificial anodic trim tab (or plate on later models) to help protect underwater metal parts from galvanic corrosion. Because of its self-sacrificing nature, trim tab (or plate) MUST BE replaced if eroded 50% or more. An anodic plate is the new service replacement for the anodic trim tab. Install the anodic plate in place of the anodic trim tab. Refer to Section 7.

Checking Optional Quicksilver Anti-Corrosion Anode Kit

If boat is equipped with Quicksilver Anti-Corrosion Anode Kit, inspect anode and replace if eroded to less than 50% of its original size. Carefully follow installation instructions, that accompany new Anode Kit, to ensure proper installation.

Boat Bottom Care

To achieve maximum performance and fuel economy, boat bottom MUST BE kept clean. Accumulation of marine growth or other foreign matter can greatly reduce boat speed and increase fuel consumption. To ensure best performance and efficiency, periodically clean boat bottom in accordance with manufacturer's recommendations.

In some areas, it may be advisable to paint the bottom to help prevent marine growth. Refer to the following information for special notes about the use of antifouling paints.

Antifouling Paint

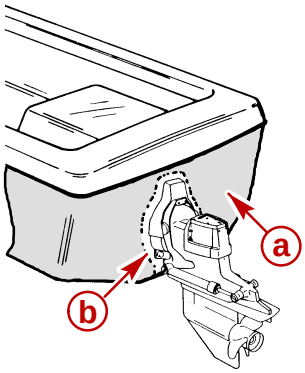
IMPORTANT: Corrosion damage that results from the improper application of antifouling paint will not be covered by the limited warranty.

Painting Boat Hull or Boat Transom: Antifouling paint may be applied to boat hull and boat transom but you must observe the following precautions:

IMPORTANT: DO NOT paint anodes or MerCathode System reference electrode and anode, as this will render them ineffective as galvanic corrosion inhibitors.

IMPORTANT: If antifouling protection is required for boat hull or boat transom, copper or tin base paints, if not prohibited by law, can be used. If using copper or tin based antifouling paints, observe the following:

- **Avoid an electrical interconnection between the Mercury MerCruiser Product, Anodic Blocks, or MerCathode System and the paint by allowing a minimum of 1-1/2 in. (40mm) UNPAINTED area on transom of the boat around these items.**



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a - Painted Boat Transom
b - Minimum 1-1/2 in. (40 mm) UNPAINTED Area Around Transom Assembly

NOTE: *Drive unit and transom assembly can be painted with a good quality marine paint or an antifouling paint that DOES NOT contain copper, tin, or any other material that could conduct electrical current. Do not paint drain holes, anodes, MerCathode system, and items specified by boat manufacturer.*

Maintaining Ground Circuit Continuity

The transom assembly and sterndrive unit are equipped with a ground wire circuit, to ensure good electrical continuity between engine, transom assembly and sterndrive components. Good continuity is essential for the MerCathode System to function effectively. Refer to Section 7.

Power Package Layup (Out of Season Storage)

Engine

Refer to appropriate Engine Service Manual.

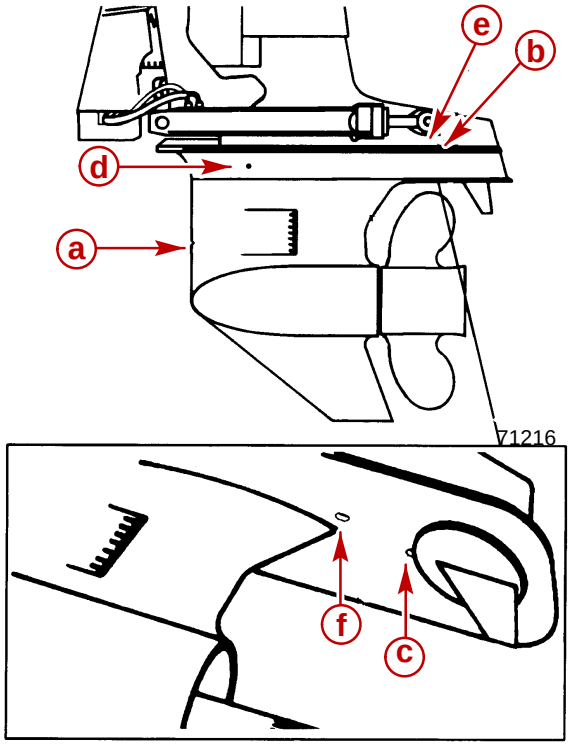
Sterndrive

1. Lubricate steering system. Refer to Section 6.
2. Lubricate transom gimbal housing assembly swivel shaft, gimbal bearing, and propeller shaft. Refer to Section 4 and Section 1-B.
3. Lubricate sterndrive unit U-joint shaft splines and cross bearings. Refer to Section 3-A.
4. Inspect U-joint bellows for cracks or other signs of deterioration. Check bellows clamps for tightness. Refer to Section 4.
5. Check engine alignment. Refer to Engine Service Manual.
6. Change sterndrive unit oil. Refer to Section 1-B.

⚠ CAUTION

Water holes in sterndrive unit MUST BE open to allow water to drain, or trapped water may freeze and cause severe damage to housings.

7. Using a piece of wire, check water drain holes in sterndrive unit to ensure that they are open.



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Sterndrive Unit Water Drain Holes

- **a** - Speedometer Pitot Tube
- **b** - Trim Tab Cavity Vent Hole
- **c** - Trim Tab Cavity Drain Passage
- **d** - Gear Housing Water Drain Hole (One Each - Port and Starboard)
- **e** - Gear Housing Cavity Vent Hole
- **f** - Gear Housing Cavity Drain Hole

8. Inspect sterndrive for damage. Repair or replace damaged components.
9. Clean sterndrive exterior surfaces and repaint any bare metal surfaces with Quicksilver Primer and Spray Paint. Refer to Section 1-B.
10. After paint has dried spray entire sterndrive with Quicksilver Corrosion Guard. Refer to Section 1-B.

⚠ CAUTION

Store sterndrive unit in the full trim DOWN/IN position. U-joint bellows may develop a “set” if unit is stored in raised position and may fail when unit is returned to service.

11. Place sterndrive unit in the full trim DOWN/IN position.
12. Store battery. Refer to battery manufacturer’s instructions.

Power Package Recommissioning

Engine

Refer to appropriate Engine Service Manual.

Sterndrive

1. Perform ALL maintenance specified for completion “At Least Once Each Year” in “Maintenance Chart” (Refer to Section 1-B), except items which were performed at the time of sterndrive layup.
2. Install fully-charged battery. Clean battery cable clamps and terminals and reconnect cables. Be sure to tighten clamps securely. Apply a thin coat of petroleum based grease to clamps and terminals to help retard corrosion.
3. After recommissioning and starting engine, check steering system and shift control for proper operation.

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IMPORTANT INFORMATION

Section 1C - Troubleshooting

1 C

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Troubleshooting

This section is a guide for performance and product troubleshooting. Referrals to specific sections of this manual are made where special tests or repair procedures are to be performed.

Because of the relationship between Power Package components (engine and sterndrive), it will be necessary in some cases to simultaneously refer to the appropriate Engine Service Manual for further troubleshooting information.

Effective troubleshooting is best enhanced by:

- Personal product knowledge and experience of the trained mechanic/technician.
- Allowing adequate time for testing and analysis.
- Utilizing these charts as a “guide” - a starting point.

Sterndrive Unit Troubleshooting

Sterndrive Unit Will Not Slide Into Bell Housing

Cause	Special Instructions
U-joint shaft splines not aligned with engine coupler splines.	Rotate propeller shaft COUNTERCLOCKWISE to align splines.
Engine not aligned.	Check engine alignment.
Gimbal bearing not properly installed.	Check engine alignment to determine if gimbal bearing is cocked or improperly installed in gimbal housing.
Damaged U-joint shaft splines and/or engine coupler splines.	Inspect and replace if necessary.

Drive Unit Does Not Shift Into Gear; Remote Control Shift Handle Moves

NOTE:*For additional information on troubleshooting, refer to SECTION 2A and see “Troubleshooting Shift Problems.”*

Cause	Special Instructions
Shift cables improperly adjusted.	Adjust shift cables.
Shift cables not connected.	Install and adjust shift cables.
Inner core wire broken or loose.	Reconnect or replace inner core wire.

Drive Unit Does Not Shift Into Gear; Remote Control Shift Handle Does Not Move

NOTE:*For additional information on troubleshooting, refer to SECTION 2A and see “Troubleshooting Shift Problems.”*

Cause	Special Instructions
Control box not properly assembled.	Properly reassemble control box.
Broken or damaged linkage in control box.	Repair linkage.
Controls improperly adjusted-cable end guide hitting brass barrel.	Adjust shift cables.

Drive Unit Shifts Hard

NOTE:*For additional information on troubleshooting, refer to SECTION 2A and see "Troubleshooting Shift Problems."*

Cause	Special Instructions
Shift cables improperly adjusted.	Adjust shift cables.
Damaged remote control or drive unit shift cable.	Replace cable(s) and adjust.
Shift cable too short (sharp bends) or too long (loops and long bends).	Select and install proper length cable.
Corroded shift cables.	Replace, adjust and check for water leakage.
Internal wear in remote control box.	Repair as needed.
Shift cable attaching nuts too tight (end cannot pivot).	Properly install nuts.
Shift cable pivot ends are corroded or not lubricated.	Clean and lubricate.

Drive Unit In Gear, Will Not Shift Out Of Gear

NOTE:*For additional information on troubleshooting, refer to SECTION 2A and see "Troubleshooting Shift Problems."*

Cause	Special Instructions
Shift cable broken.	Replace cable and adjust.
Cable end not connected in drive unit.	Remove and reinstall drive unit.
Remote control damaged.	Repair or replace remote control.
Internal shift mechanism damage.	Repair or replace as necessary.

Gear Housing Noise

Cause	Special Instructions
Metal particles in drive unit lubricant.	Disassemble, clean and inspect and replace necessary components. (Refer to SECTION 3B, 3C or 3D)
Propeller incorrectly installed.	Inspect mounting hardware. Install propeller correctly.
Propeller shaft bent.	Inspect and replace if necessary. (Refer to SECTION 3B, 3C or 3D)
Incorrect gear shimming.	Check gear housing backlash and pinion gear height. (Refer to SECTION 3B, 3C or 3D)
Worn or damaged gears and/or bearings caused by impact, overheating or improper shimming.	Disassemble, inspect and replace. (Refer to SECTION 3B, 3C or 3D)

Drive Shaft Housing Noise

Cause	Special Instructions
Engine flywheel housing contacting inner transom plate or exhaust pipe.	Determine cause for interference (loose engine mounts, transom too thin, etc.) and correct as necessary.
Propeller with untrue or out-of-balance blades.	Repair or replace, as required.
Abnormal sterndrive operation.	Instruct operator on proper operating technique.
U-joint cross and bearing assembly retaining rings improperly installed or of incorrect size.	Make sure that proper thickness retaining rings are used and that rings are fully seated in U-joint bearing cap grooves. (Refer to SECTION 3A)
Excessive side-to-side play in U-joint cross and bearing assemblies.	Replace cross and bearing assembly.
U-joint bearing caps contacting U-joint bellows retention sleeve.	Make sure proper cross and bearing assemblies are used. If interference is severe, replace cross and bearing assembly and / or sleeve assembly.
U-joint cross and bearings rough.	Replace assemblies. Signs of scoring, galling or roughness are the result of lack of lubricant. (Refer to SECTION 3A)
O-rings missing or flattened out on U-joint shaft causing shaft to rattle against ID of gimbal bearing.	Install new O-rings. (Refer to SECTION 3A)

Drive Shaft Housing Noise (Continued)

Cause	Special Instructions
Worn U-joint shaft splines and/or engine coupler splines.	Remove U-joint coupling end yoke and insert into gimbal bearing and engine coupling. Rotate shaft back and forth. If play is excessive, replace U-joint coupling end yoke and/or engine coupler, as necessary.
Engine alignment incorrect or engine coupler crooked.	Adjust alignment. Ensure that alignment tool moves in and out of coupler freely. After proper alignment has been obtained, check for a crooked coupler by rotating engine coupler 1/2 turn and rechecking alignment. If proper alignment is no longer observed, coupler is crooked and must be replaced. (Refer to SECTION 2)
Gimbal bearing rough.	Replace gimbal bearing. (Refer to SECTION 4) **IMPORTANT: Gimbal bearing and carrier MUST BE replaced as an assembly because they are a matched set. Failure to do this may result in a loose bearing fit in carrier.**
Loose gimbal bearing.	Reinstall bearing assembly using a new tolerance ring if carrier is loose in gimbal housing. If bearing is loose in carrier, bearing assembly must be replaced. (Refer to SECTION 4)
Gimbal bearing not fully seated in gimbal housing.	Drive bearing assembly into place.
Excessive clearance between gimbal ring and gimbal housing. This could cause misalignment between bell housing and gimbal housing and also may allow gimbal ring to vibrate up and down.	Check and adjust clearance. (Refer to SECTION 4)
Improperly installed or failed rear engine mounts. This will affect engine alignment, but usually is not detectable with engine alignment tool.	Check for uneven mount height, or loose or soft mounts. Make sure there is clearance between flywheel housing and fiber washer. If no clearance exists, mounts have probably sagged. Install mounts correctly or replace, as necessary.

Drive Shaft Housing Noise (Continued)

Cause	Special Instructions
Boat transom too thin. **Thickness:** 2 in. (51 mm) minimum, 2-1/4 in. (57 mm) maximum.	Add thickness to transom.
Boat transom thickness uneven. This could affect engine to transom assembly alignment and is usually not detectable with alignment tool. **Variation:** 1/8 in. (3 mm) maximum.	Repair boat as necessary.
Bell housing contacting gimbal ring. This would cause knocking in the fully trimmed IN position only.	Check for soft or split trim cylinder bushings and loose or worn hinge pin bushings. (Refer to SECTION 5B)
Stringer height uneven or transom assembly installed cocked on boat transom. This will affect engine alignment, but is usually not detectable with alignment tool.	Measure the distance between the engine flywheel housing and the inner transom plate on both sides. If distances are uneven, the problem may be due to uneven stringer height or a cocked transom assembly. Adjust the stringer height or relocate the transom cutout as required.
Weak boat transom or boat bottom that flexes under power and causes engine misalignment - this condition will usually cause engine coupler failure.	This condition can sometimes be detected by having someone apply force to the top of the drive unit while watching the inner transom plate. If movement can be observed, the transom is weak and must be repaired.
Rear engine mount attaching hardware improperly installed or missing.	Reinstall hardware correctly.
Engine mounting holes drilled off-center in inner transom plate engine supports or engine flywheel housing	Make sure the holes are equally spaced fore and aft and are equal distance from the centerline.
Misalignment between bell housing, gimbal housing and engine coupler.	Contact your service center and arrange to have a technical service representative check the unit using a special gauge.

Performance Troubleshooting

Low WOT Engine Rpm

Cause	Special Instructions
Improper drive unit trim angle.	Properly adjust drive unit trim angle.
Damaged propeller.	Repair or replace.
Improper propeller pitch.	Water test boat using a lower pitch propeller.
Dirty or damaged boat bottom.	Clean and/or resurface boat bottom.
Drive installation too low on transom.	Contact boat manufacturer for installation specifications.
Permanent “hook” in boat bottom (some boats are built with a slight “hook” for correct boat performance).	Check for a hook in the boat bottom by placing a straight edge, at least 6 ft. (2 m) long, under the bottom edge of the transom. If a hook is found, contact the boat manufacturer.
“Power hook” or weak boat bottom.	Water test boat. Boat will perform normally until hook develops at high speed, then loss of rpm and speed will occur. Contact boat manufacturer.

High WOT Engine Rpm

Cause	Special Instructions
Propeller ventilating.	Determine cause for ventilation.
Improper propeller pitch.	Water test boat using a higher pitch propeller.
Propeller hub slipping.	Replace hub or replace propeller.
Drive installation too high on transom.	Contact boat manufacturer for installation specifications.
Engine coupler hub spun.	Replace coupler.

Propeller Ventilating/Cavitating

Cause	Special Instructions
Drive unit trimmed too high.	Trim drive unit IN/DOWN.
Incorrect propeller.	Install correct propeller.

Poor Boat Performance And/Or Poor Maneuverability-Bow Too Low

Cause	Special Instructions
Improper drive unit trim angle.	Properly adjust drive unit trim angle.
Boat is bow heavy.	Redistribute boat load to stern. If bow overweight is caused by permanently installed fuel tank(s), contact the boat manufacturer.
Boat is underpowered.	Check horsepower to weight ratio. Contact the boat manufacturer.

Permanent hook in boat bottom (some boats are built with a slight hook for correct boat performance).	Check for a hook in the boat bottom by placing a straight edge, at least 6 ft. (2 m) long, under the bottom edge of the transom. If a hook is found, contact the boat manufacturer.
Power hook or weak boat bottom.	Water test boat. Boat will perform normally until hook develops at high speed, then loss of rpm and speed will occur. Contact boat manufacturer.

Poor Boat Performance And/Or Poor Maneuverability-Bow Too High

Cause	Special Instructions
Improper drive unit trim angle.	Properly adjust drive unit trim angle.
Boat is stern heavy.	Redistribute boat load to bow. If stern overweight is caused by permanently installed fuel tank(s), contact the boat manufacturer.
Propeller pitch too high.	Water test the boat using a lower pitch propeller.
Permanent rocker in boat bottom (some boats are built with a slight rocker for correct boat performance).	Check for a rocker in the boat bottom by placing a straight edge, at least 6 ft. (2 m) long, under bottom edge of the transom. If a rocker is found, contact the boat manufacturer.
Power hook or weak boat bottom.	Water test boat. Boat will perform normally until hook develops at high speed, then loss of rpm and speed will occur. Contact boat manufacturer.

Power Steering

If Power Package is equipped with Power Steering, first determine if problem is caused by the Power Steering System or the Ride Guide portion of the Steering System.

1. Remove clevis pin which attaches steering cable to power steering unit piston rod end clevis. Remove clevis pin which secures piston rod end clevis to sterndrive steering lever.
2. Turn steering wheel through entire steering range. If steering difficulty is encountered, it is located in the Ride Guide Steering System. If steering wheel turns with ease, problem is located in Power Steering System.

Hard Steering - Helm And Cable

Cause	Special Instructions
Damaged steering cable.	Replace cable. (Refer to SECTION 2)
Steering cable too short (sharp bends) or too long (loops and long bends).	Select and install proper length cable. (Refer to SECTION 2A)
Steering cable corroded or not lubricated.	Lubricate or replace the cable.
Over-lubed cable.	Replace cable.
RideGuide™ rack or rotary head not lubricated.	Disassemble and lubricate.

Hard Steering (Engine Running) - Power Steering System

Cause	Special Instructions
Low power steering pump fluid level.	Check fluid level. (Refer to SECTION 6A)
Loose power steering pump drive belt.	Adjust belt tension. (Refer to SECTION 6A)
Air in system.	Cycle to remove air. (Refer to SECTION 6A)
Fluid leak.	Locate and correct source of leak. (Refer to SECTION 6A)
If the above 4 steps do not solve the problem, test the power steering system.	Test power steering system. (Refer to SECTION 6A)

Power Steering System External Fluid Leaks

Cause	Special Instructions
Pump reservoir leaking at fill cap (reservoir too full).	Remove fluid to bring to proper level.
Pump reservoir leaking at fill cap (air or water in fluid).	Locate source of air or water and correct. Air may enter because of low reservoir fluid level or internal pump leak. Test pump. (Refer to SECTION 6A)
Loose hose connections.	Tighten hose connections.
Damaged hose.	Replace hose.
Bad cylinder piston rod seal.	Replace cylinder.
Damaged or worn control valve seals.	Replace cylinder.
Bad power steering pump seals and O-rings.	Repair pump. (Refer to SECTION 6A)
Cracked or porous metal parts.	Replace part(s).

Compact Hydraulic Steering

Important Information

Whenever a troubleshooting solution calls for removal from vessel and/or dismantling of steering system components, such work must be carried out by a qualified marine mechanic. The following is offered as a guide only and neither Mercury MerCruiser nor the helm manufacturer are responsible for any consequences resulting from incorrect repairs.

Most faults occur when the installation instructions are not followed and usually show up immediately upon filling the system. The most common faults encountered and their likely cause and solution are provided in the following.

Sometimes when returning the steering wheel from a locked position, a slight resistance may be felt and a clicking noise may be heard. This should not be mistaken as a fault, as it is a completely normal situation caused by the releasing of the lockspool in the system.

⚠ WARNING

Avoid serious injury or death due to FIRE or EXPLOSION. Be sure that engine compartment is well ventilated and that no gasoline vapors are present to prevent the possibility of a FIRE or EXPLOSION.

Helm Becomes Jammed During Filling

Cause	Special Instructions
Blockage in the line between the helm(s) and the cylinder(s).	Make certain that hoses were not kinked or pinched during installation. If so, the hose must be removed and replaced.

System Difficult To Fill

Cause	Special Instructions
Air in system.	Review filling instructions.

Steering Hard To Turn

Cause	Special Instructions
Steering cylinder pivot bushings are too tight or trunion is bent, causing mechanical binding.	To test, disconnect clevis from steering lever and turn the steering wheel. If it now turns easy, correct cause of mechanical binding. Please note that excessively loose connections to steering cylinder or steering lever can also cause mechanical binding.
Restrictions in hoses.	Find restrictions and correct.
Air in hydraulic fluid.	See filling and purging instructions.
Wrong hydraulic fluid has been used to fill steering system.	Drain system and fill with approved hydraulic fluid.

Helm Unit Bumpy - Requires Too Many Turns

Cause	Special Instructions
Dirt in inlet check of helm pump.	Replace helm unit.

Power Trim Electrical System

NOTE:*Refer to "Power Trim System Wiring Diagram."*

Power Trim Pump Motor Will Not Run In The OUT/UP Or IN/DOWN Direction

SOLENOIDS DO NOT CLICK

Cause	Special Instructions
Bad electrical connection at the 110 amp fuse or at the battery or the harness came unplugged from the pump	Check all electrical connection points
20 amp fuse blown.	Determine cause for the blown fuse and correct before replacing fuse. ***NOTE:****If fuse blows while trimming OUT/UP or raising drive unit, problem may be due to grounded trim limit switch leads. To check for grounded condition, disconnect trim limit switch leads at bullet connector* ***14****,* ***15****,* ***16*** *and* ***17****. If drive unit can now be raised (using "Trailer" switch), trim limit switch or leads are grounded.*
Power trim pump battery cables or wiring harness connections corroded or loose.	Clean and/or tighten connections **1**, **2**, **4**, **10**, **11**, **12** and **18** as necessary.
Trim control wiring harness connector loose or corroded.	Clean and secure connection **13** as necessary.
110 amp fuse blown (does not apply to intermittent problem).	Check for voltage at terminal **4**. If no voltage indicated, determine cause of blown fuse.
Open circuit in trim control wiring harness.	Check for battery voltage at terminal **8** while trimming OUT/UP and at terminal **6** while trimming OUT/UP. If no voltage is indicated, check trim control for a loose or corroded connection or a damaged power supply lead in harness.
Thermal circuit breaker in pump motor open.	Replace commutator end plate assembly.

Power Trim Pump Motor Will Not Run In The OUT/UP Or IN/DOWN Direction

BOTH SOLENOIDS CLICK

Cause	Special Instructions
Faulty solenoids or loose or corroded connections.	Check for battery voltage at terminals **5** while trimming OUT/UP. If no voltage is indicated, check connections **2**, **3**, **4** and **5** and/or replace solenoids.
Pump motor brushes stuck, corroded or worn out.	Clean or replace as required.
Armature commutator dirty.	Clean or replace armature as required.
Armature faulty.	Test for shorted, open or grounded condition and replace if needed.
Field and frame faulty.	Check for open or grounded condition. Replace field and frame assembly if needed.
Water or oil in motor.	Replace motor assembly.
Pump gears frozen.	Replace pump valve body and gear assembly.
Power trim pump harness or trim control harness shorted between OUT/UP and IN/DOWN circuit (pump trying to run in OUT/UP and IN/DOWN direction simultaneously).	Disconnect BLU/WHI lead from solenoid terminal **8**. If pump motor will now run in the OUT/UP direction, a short in the harness exists. Repair or replace harness as needed.

Power Trim Pump Motor Runs In The OUT/UP Direction, But Not In The IN/DOWN Direction

IN/DOWN SOLENOID DOES NOT CLICK

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections **6** and **7** and clean and/or tighten as required.
Open IN/DOWN circuit in trim control or pump wiring harness.	Check for battery voltage at terminal **6** while trimming OUT/UP. If no voltage is indicated, check for a loose or corroded OUT/UP circuit connection, damaged OUT/UP circuit lead or a faulty OUT/UP trim switch. Repair or replace as required.
Solenoid faulty.	Replace solenoid.

Power Trim Pump Motor Runs In The OUT/UP Direction, But Not In The IN/DOWN Direction

IN/DOWN SOLENOID CLICKS

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections **4** and **5.** Clean and/or tighten as necessary.
Faulty solenoid.	Check for battery voltage at terminal **5** while trimming IN/DOWN. If no voltage is indicated, replace solenoid.
Faulty IN/DOWN field winding.	Replace field and frame assembly.

Power Trim Pump Motor Runs In The IN/DOWN Direction, But Not In The OUT/UP Direction-Both Trim And Trailer Switches Inoperative-

OUT/UP SOLENOID DOES NOT CLICK

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections **8** and **9**. Clean and/or tighten as necessary.
Open OUT/UP circuit trim control or pump wiring harness.	Check for battery voltage at terminal **8** while trimming OUT/UP. If no voltage is indicated, check for a loose or corroded OUT/UP circuit connection, blown fuse (if trim control is equipped), damaged OUT/UP circuit lead or a faulty OUT/UP trim switch. Repair or replace as necessary.
Faulty solenoid.	Replace solenoid.

Power Trim Pump Motor Runs In The IN/DOWN Direction, But Not In The OUT/UP Direction-Both Trim And Trailer Switches Inoperative

OUT/UP SOLENOID CLICKS

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections **2** and **3**. Clean and/or tighten as necessary.
Faulty solenoid.	Check for battery voltage at terminal **3** while trimming OUT/UP. If no voltage is indicated, replace solenoid.
Faulty OUT/UP field winding.	Replace solenoid.

Trim Control OUT/UP Trim Switch Inoperative

TRAILER SWITCH OPERATES

Cause	Special Instructions
Trim limit switch lead bullet connectors loose or corroded.	Clean and/or tighten connections **14**, **15**, **16** and **17** as necessary.
Faulty trim limit switch or leads.	Disconnect trim limit switch leads from trim harness. Connect a continuity meter between leads **16** and **17**. Continuity should be indicated with drive unit in full IN/DOWN position. If not, check for damaged leads or poor connections. If this is not the cause, replace limit switch.
Open trim control OUT/UP circuit.	Check for a loose or corroded OUT/UP circuit connection, damaged OUT/UP circuit lead or faulty OUT/UP trim switch. Repair or replace as necessary.

Trim Control Trailer Switch Inoperative

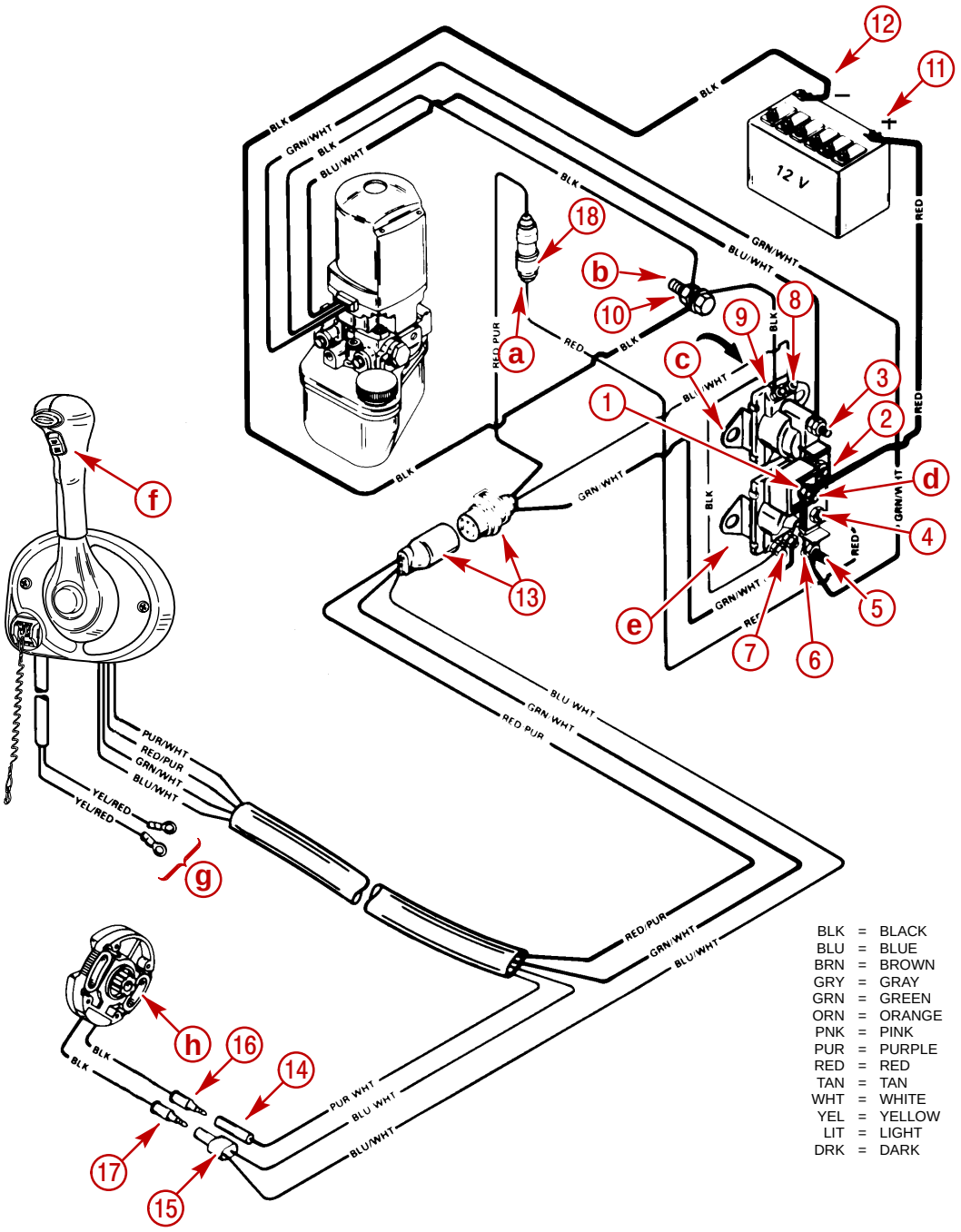
TRIM OUT/UP SWITCH FUNCTIONS

Cause	Special Instructions
Open trim control trailer circuit.	Check for a faulty trailer switch, loose or corroded connections or damaged trailer circuit lead.

Trim System Functions While Unattended

Cause	Special Instructions
Faulty trim or trailer switch.	Replace switch.
Shorted trim pump harness or trim control harness.	Repair or replace as required.

Power Trim System Wiring Diagram



NOTE:*Numbered callouts refer to Power Trim Electrical System Troubleshooting Chart.*

- **a** - 20 Amp Fuse
- **b** - Ground Bolt (Floor Mount)
- **c** - UP Solenoid
- **d** - 110 Amp Fuse
- **e** - DOWN Solenoid
- **f** - Trim/Trailer Switch
- **g** - Neutral Switch to Instrument Wiring Harness
- **h** - Trim Limit Switch

Power Trim Hydraulic System

NOTE:*Refer to "Power Trim Hydraulic Schematic."*

Drive Unit Cannot Be Trimmed OUT/UP Or Trims Slowly Or With Jerky Movements

Cause	Special Instructions
Power trim pump oil level low.	Check for cause of low oil level and correct. Add oil and bleed trim system.
Air in trim system.	Check for cause of entry and correct. Add oil to pump and bleed air from system.
O-rings damaged on Manual Release Valve (if equipped) or valve not completely closed.	Replace valve and/or close completely.
Insufficient pump pressure or pump. shuttle valve stuck.	Test. If shuttle **1** is stuck, replace pump adaptor (Refer to SECTION 5A). If pressure is low, replace adaptor or attempt to repair by replacing the following components: ● OUT/UP Pressure Relief Valve ● Thermal Relief Valve
Hoses reversed on one cylinder only.	Connect hoses **7** and **8** correctly.
Trim cylinder(s) binding.	Check for cause of binding (bent piston rod, scored cylinder). Repair or replace as necessary.
Gimbal housing-to-trim pump hydraulic hose pinched.	Replace hose **7**.
Up pressure relief valve has dirt particles under check ball.	Replace with a new valve kit.

Drive Unit Will Not Stay In Trimmed OUT/UP Position

Cause	Special Instructions
Air in trim system.	Check for cause of entry. Fill and bleed system.
Shuttle valve (poppet valve).	Check for dirt. Install new poppet valve.

Sterndrive Unit Trails OUT/UP On Deceleration Or When Shifting Into Reverse

UNIT THUMPS WHEN SHIFTING

Cause	Special Instructions
Trim pump IN/DOWN circuit leaking internally.	Test according to appropriate service manual. Replace adaptor or attempt to repair by replacing the pilot check valves or seals. (Install Trim Pump Rebuild Kit)

Oil Foams Out Of Pump Fill/Vent Screw

Cause	Special Instructions
Contaminated oil.	Flush system with clean oil refill pump and bleed trim system.
Oil level low.	Check for cause of low oil level and correct. Add oil to pump and bleed system.

Sterndrive Unit Cannot Be Lowered From UP Position Or Lowers With Jerky Movements

Cause	Special Instructions
Air in trim system.	Check for cause of entry. Fill and bleed trim system.
Low oil level.	Add oil.
Insufficient IN/DOWN pressure or shuttle valve stuck.	Test. If shuttle **1** is stuck, replace pump adaptor. (Refer to SECTION 5A) If pressure is low, replace adaptor or attempt to repair by replacing the following items: ● IN/DOWN pressure relief valve **1**
Trim cylinder(s) binding.	Check for cause of binding. Repair or replace as necessary.
Gimbal housing-to-trim pump hydraulic hose pinched.	Replace hose **8**.
Hoses reversed on one trim cylinder only.	Reconnect hoses correctly.
Drive unit binding in gimbal ring.	Check for cause of binding and replace.
Down pressure relief valve (6) has dirt particles under check ball.	Replace with a new valve kit.

Sterndrive Unit Will Not Stay In Full UP Position For Extended Periods

Cause	Special Instructions
External leakage.	Check for cause and correct. Add oil to pump and bleed trim system.
Pump OUT/UP circuit leaking internally.	Test. (Refer to SECTION 5A) Replace adaptor **2** or attempt to repair by replacing the following: ● Thermal relief valve **4** ● Poppet valve seals **9**
Trim cylinder(s) leaking internally and pump DOWN circuit leaking internally (both must be faulty to cause this problem).	Rebuild cylinders **5** Repair or replace adaptor **2** as required.

Sterndrive Will Not Stay In The Trimmed OUT/UP Position When Underway

Cause	Special Instructions
Air in trim system.	Check for cause of entry. Fill and bleed system.
Leaky poppet valve.	Install repair kit for poppet valve **1**.

Sterndrive Unit Trails OUT/UP On Deceleration Or When Shifting Into Reverse

UNIT THUMPS WHEN SHIFTING

Cause	Special Instructions
Trim cylinders(s) leaking internally.	Test. (Refer to SECTION 5A) Rebuild or replace cylinders as necessary.
Trim pump IN/DOWN circuit leaking internally.	Test. (Refer to SECTION 5A) Replace adaptor or attempt to repair by replacing the following: ● Pilot check valves or seals **9** ● Install trim pump rebuild kit

Oil Foams Out Of Pump Fill/Vent Screw

Cause	Special Instructions
Contaminated oil.	Flush system with clean oil refill pump and bleed trim system.
Oil level low.	Check for cause of low oil level and correct. Add oil to pump and bleed system.

Trim Motor Runs But Does Not Pump Oil

Cause	Special Instructions
Broken coupler between the pump and the motor.	Replace the coupler.
Plugged pick-up screens.	Replace pick-up screens.

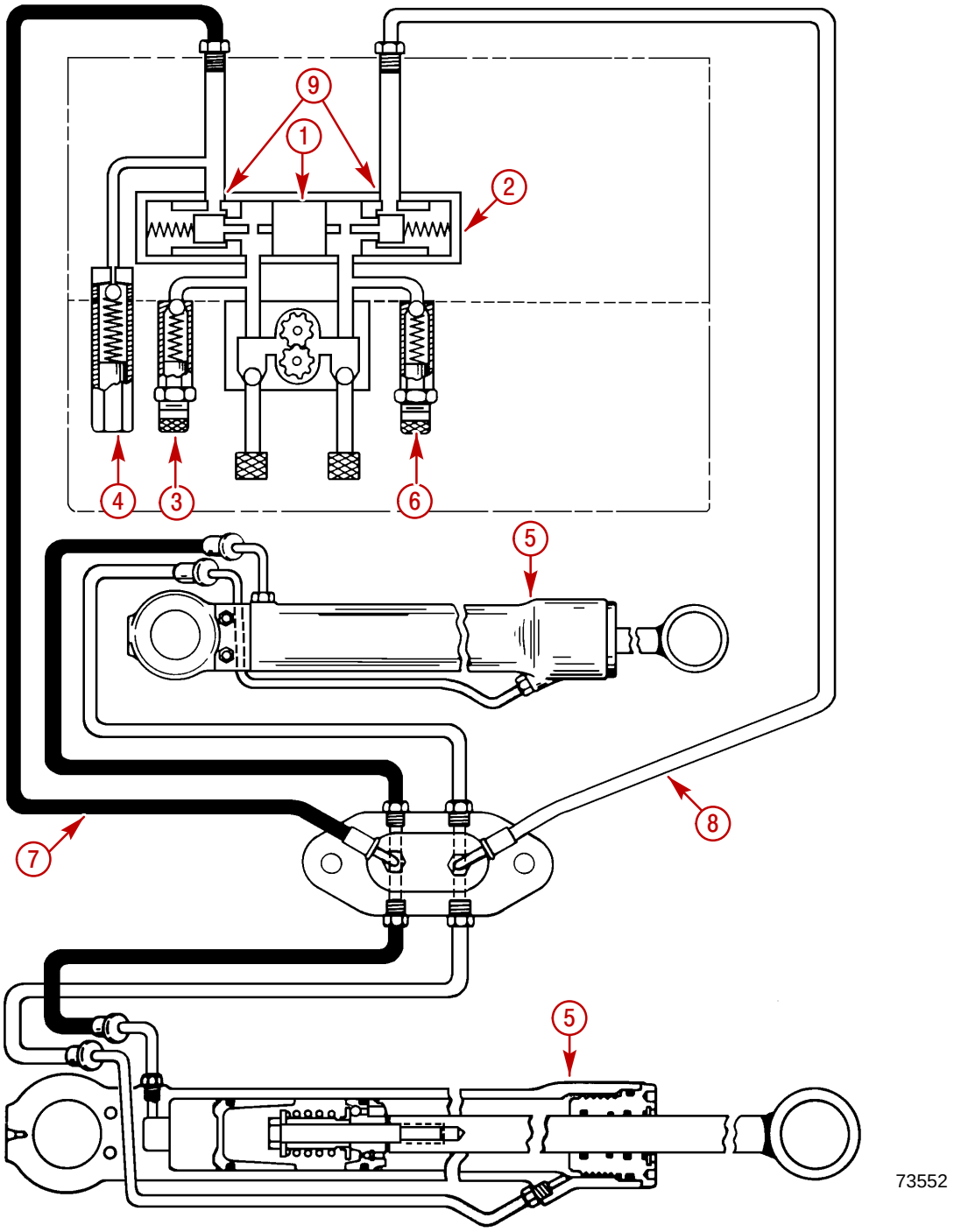
Trim Pump Runs Slowly In Both Directions

Cause	Special Instructions
Check the condition of the oil It may be contaminated and thick like honey.	Remove the reservoir and clean out the contaminated oil.

Trim Pump Runs Slowly With A Laboring Sound

Cause	Special Instructions
A possible tight adaptor pump gear or water or oil in the motor.	Replace the pump assembly in the adaptor or replace the electric motor assembly.

Power Trim Hydraulic Schematic



1 - Shuttle
2 - Pump Adaptor
3 - UP/OUT Pressure Relief Valve
4 - Thermal Relief Valve
5 - Trim Cylinder
6 - IN/DOWN Pressure Relief Valve
7 - UP/OUT Hose
8 - IN/DOWN Hose
9 - Poppet Valves

Auto Trim II Electrical System

NOTE:*Refer to "Auto Trim II System Wiring Diagram."*

Pump Motor Will Not Run UP Or DOWN In Either Manual Or Auto Mode

SOLENOIDS CLICK

Cause	Special Instructions
Pump positive battery cable connection loose or corroded.	Check cable **14**.
110 amp fuse blown or loose or corroded solenoid connection.	Check for voltage at terminal **5**.
Pump motor brushes stuck, corroded or worn out.	Clean or replace.
Armature commutator dirty.	Clean or replace.
Armature faulty.	Test and replace if bad.
Field and frame faulty.	Test and replace if bad.
Pump gears frozen.	Replace pump.
Trim harness shorted between UP and DOWN circuit.	Disconnect blue-white lead **2** from solenoid terminal. If pump motor will now run in the DOWN direction, a short in the harness is indicated.

SOLENOIDS DO NOT CLICK

Cause	Special Instructions
Pump negative battery cable loose, corroded or damaged.	Check cable **13** for damage or a loose or corroded connection.
Mode switch wiring harness connector is loose at pump.	Secure connection **47**.
Faulty thermal circuit breaker in pump motor.	Connect a jumper wire between terminals **1** and **7**. If pump now operates, circuit breaker is faulty and field and frame assembly must be replaced.
Open circuit in mode switch wiring harness.	With ignition switch in RUN position and mode switch in MANUAL mode, check for voltage at terminal **8** while trimming UP and terminal **12** while rimming DOWN. If no voltage is indicated, refer to items **5** and **6** immediately following.
No power to mode switch.	Check for voltage at terminal **25** (with ignition switch in RUN position). If no voltage is indicated, check power lead for a poor connection.
Faulty mode switch.	Check for voltage at terminal **24** (with mode switch in AUTO mode) and terminal **26** (with switch in the MANUAL mode). Replace switch if no voltage is indicated.

Pump Motor Will Not Stop Running Down In Auto Mode

TRIM UP/OUT SWITCH AND TRAILER SWITCH INOPERATIVE IN MANUAL MODE

NOTE:*An internal timer in the control module stops the pump motor 50 seconds after this problem condition occurs.*

Cause	Special Instructions
Loose or dirty solenoid connection.	Check connections **7** and **8**.
Faulty solenoid.	Check for voltage at terminal **8** while trimming UP (in MANUAL mode). If voltage exists, an open condition in solenoid is indicated and solenoid must be replaced. If no voltage is indicated, refer to steps 3 through 6 following.
Loose or corroded trim limit switch lead connections.	Check connections **32** and **36**.
Faulty trim limit switch.	Disconnect trim limit switch leads **32** and **36** and connect a continuity meter between leads. Continuity should exist with drive unit in DOWN position. If not, readjust or replace switch as necessary.
Open circuit in wiring harness.	Check leads **30**, **35**, **46** and **2** for loose or corroded connections or damage.
Faulty control module.	Replace.

Pump Motor Will Not Run Up Or Down In Auto Mode

MANUAL MODE FUNCTIONS PROPERLY

Cause	Special Instructions
Control module 20 amp fuse blown.	Determine cause for blown fuse and correct before replacing fuse.
Open in control module battery cables or wiring harness.	Check cables **16** and **18** and lead **20**.
Faulty mode switch.	Check for voltage at terminal **24** and **25** with switch in AUTO mode. If voltage exists at terminal **25**, but not **24**, switch is faulty.
Faulty control module.	Replace.

Trim System Completely Inoperative In Manual Mode

AUTO MODE FUNCTIONS PROPERLY

Cause	Special Instructions
Faulty mode switch.	Check for voltage at terminal **26** with mode switch in MANUAL mode. If no voltage is indicated, replace switch.
Open circuit in wiring harness.	Check leads **27** and **33** for loose or corroded connections or damage.

Pump Motor Will Run UP, But Not DOWN In Both Manual And Auto Modes

DOWN SOLENOID DOES NOT CLICK

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections **4**, **7** and **12**.
Faulty mode switch or open in DOWN circuit.	Check for voltage at terminal **12** while trimming Down (in MANUAL mode). If no voltage is indicated, repeat test at terminal **22** and **23**. If voltage exists at terminal **23**, but not at **22**, switch is faulty. If voltage is present at terminal **22**, check leads **3** and **48** and connector **47** for an open condition.
Faulty DOWN solenoid.	Replace solenoid.

DOWN SOLENOID CLICKS

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections **10** and **11**.
Faulty solenoid.	Check for voltage at terminal **11** while trimming Down (in MANUAL mode). If no voltage is indicated, replace solenoid.
Faulty DOWN field winding.	Replace field and frame.

Pump Motor Runs DOWN, But Not UP In Both The Manual And Auto Modes

UP SOLENOID CLICKS

Cause	Special Instructions
Loose or dirty solenoid connections.	Check connections **5** and **6**.
Faulty solenoid.	Check for voltage at terminal **6** while trimming UP. If no voltage is indicated, replace solenoid.
Faulty UP field winding.	Replace field and frame.

Pump Motor Will Run DOWN, But Not UP In Auto Mode

MANUAL MODE FUNCTIONS PROPERLY

Cause	Special Instructions
Open circuit in control module sense lead.	Check lead **17** for loose or corroded connections or damage.
Faulty control module.	Replace.

Pump Motor Will Run UP, But Not DOWN In Auto Mode

MANUAL MODE FUNCTIONS PROPERLY

Cause	Special Instructions
Faulty mode switch.	Check for voltage at terminal **21** and **22** while turning ignition switch to RUN position (in AUTO mode). If voltage exists at **21** but not at **22**, switch is faulty.
Open circuit in wiring.	Check lead **19** for a loose or corroded connection or damage.
Faulty control module.	Replace.

Trim DOWN/IN Switch Inoperative In Manual Trim Control

TRIM UP/OUT SWITCH AND TRAILER SWITCH FUNCTION, AUTO MODE FUNCTIONS PROPERLY

Cause	Special Instructions
Faulty DOWN switch in manual trim control.	Check for voltage at terminal **38** while trimming DOWN (in MANUAL mode). If no voltage is indicated, switch is faulty.
Open circuit in wiring harness.	Check for voltage at terminal **23** while trimming DOWN. If no voltage is present, check leads **28** and **34** for a loose or corroded connection or damage.
Faulty mode switch.	Check for voltage at terminal **22** while trimming DOWN. If no voltage exists, switch is faulty.

Trim UP/OUT Switch Inoperative In Manual Trim Control

TRIM DOWN/IN SWITCH FUNCTIONS, AUTO MODE FUNCTIONS PROPERLY

Cause	Special Instructions
Trim 20 amp fuse “43” blown (if equipped).	Determine cause for blown fuse and correct before replacing fuse.
Open in power supply lead to trim and trailer switch.	Check voltage at terminal **44**. If no voltage is indicated, check lead **45** for a poor connection or damage.
Faulty trim UP/OUT switch (applies only to trim controls where it is necessary to actuate trim UP switch in order for trailer switch to function).	Check for voltage at terminal **40** while actuating trim UP/OUT switch. Replace switch if no voltage is indicated.

Trailer Switch In Manual, Trim Control Inoperative

TRIM UP/OUT SWITCH FUNCTIONS

Cause	Special Instructions
Faulty trailer switch.	Check for voltage at terminal **41** and **42** while actuating trailer switch. If voltage exists at terminal **42**, but not at terminal **41**, a faulty switch is indicated. If no voltage exists at terminal **42**, check power supply lead for an opening.
Opening in wiring.	Check lead **39** for damage or a loosened or corroded connection.

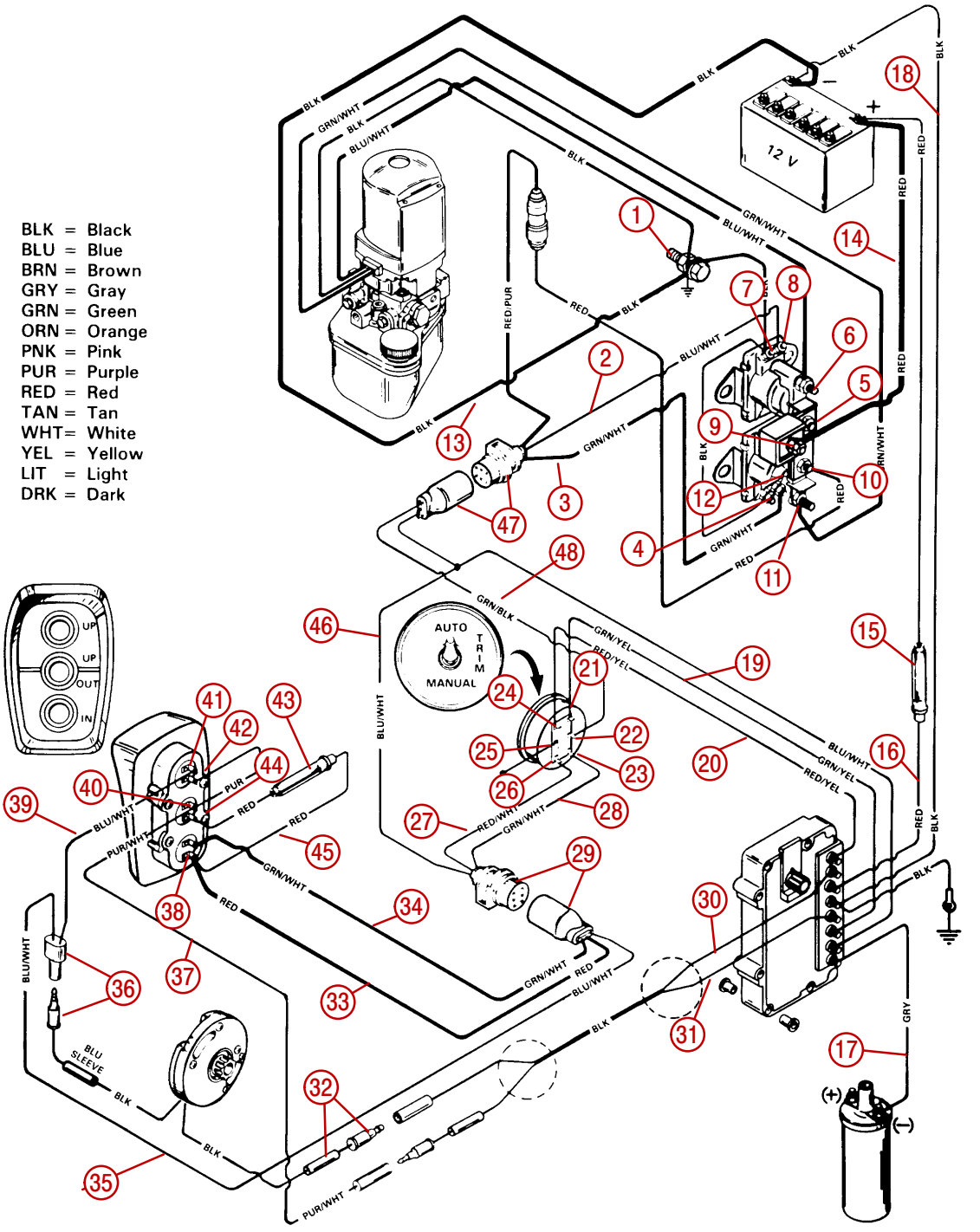
Boat Is On Plane Well Before Drive Unit Begins To Trim Out

Cause	Special Instructions
Control module adjustment incorrect.	Adjust. (Refer to SECTION 5)
Faulty control module.	Replace control module.

Boat Is Not On Plane Before Drive Unit Begins To Trim Out

Cause	Special Instructions
Control module adjustment incorrect.	Adjust. (Refer to SECTION 5)
Faulty control module.	Replace control module.

Auto Trim II System Wiring Diagram



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Corrosion Protection

NOTE:*Refer to "MerCathode Controller Wiring Diagram."*

Corrosion On Underwater Parts, Without MerCathode Or Impressed Current Protection

Cause	Special Instructions
Sacrificial anode(s) consumed.	Replace anode(s) when 50% consumed.
Stainless steel propeller installed.	Add MerCathode (impressed current protection) or additional sacrificial anodes.
Sacrificial anode(s) not grounded to drive.	Remove anode(s), clean contact surface, reinstall and check continuity.
Loss of continuity between underwater parts & ground.	Provide good ground connections.
Shore power causing overload of anode(s) and/or MerCathode.	Disconnect shore power or install Quicksilver isolator.
Paint on drive heavily worn (exposing more metal).	Prime and repaint and/or install additional anode(s).
Sacrificial anode(s) painted.	Remove paint or replace anode(s).
Drive tilted so far that anode(s) are out of the water.	Leave drive down, install additional anode (below waterline) or transom mount a MerCathode.
Only power trim cylinders are corroded.	Provide good ground to drive. All parts must be grounded.
Corrosion in area of exhaust outlets. Exhaust deposits can cause corrosion.	Remove deposits with marine or auto wax.
Corrosion occurring after unit removed from saltwater.	Wash exterior and flush interior with fresh water.
Corrosion and/or salt build up between mating parts.	Exclude moisture from between mating parts with Quicksilver 2-4-C with Teflon.
Stainless Steel parts corroding: Tightly wrapped fishing line or foreign material excludes oxygen, causing corrosion. Iron particles, such as from a wire brush, cause rusting. Propeller pitting can occur if electrical continuity is lost.	Clean parts, remove foreign material, ensure continuity.

Corrosion On Underwater Parts, With MerCathode Or Impressed Current Protection

DRIVE CORRODING

Cause	Special Instructions
Poor connection between reference electrode (BRN) lead or anode (ORN) lead and MerCathode controller.	Clean and/or tighten connection. Repair wiring.
Faulty MerCathode reference electrode.	Disconnect reference electrode lead (BRN) from the controller “R” terminal. Connect the lead to positive (+) terminal of a digital multi-meter (set on 0-2000 millivolt scale). Connect negative (–) meter lead to negative (–) battery terminal. Note meter reading; then repeat the test with a test silver/silver chloride reference electrode held behind the drive. The same reading should be obtained in both cases. If not, replace the reference electrode.
Faulty MerCathode controller.	With anode and reference electrode leads connected to controller, connect a jumper wire between “R” and negative(–) terminals on controller. Connect positive (+) lead of volt meter (set on 0-20 scale) to “A” terminal on controller. Connect the negative (–) meter lead to the negative (–) controller terminal. Reading should be as follows: ● Freshwater Areas = 11.5 volts minimum ● Seawater Areas = 3.55 volts minimum If the reading is low, replace the controller.
Too much cathode (such as stainless steel).	MerCathode system overpowered by large quantity of stainless steel below the waterline.
Loss of continuity between sterndrive components and ground.	Ensure continuity (check continuity wires and washers).
Sacrificial anodes consumed, painted or inoperative.	Replace anodes.
MerCathode reference electrode or anode painted.	Remove paint or replace anode or MerCathode reference electrode.

DRIVE CORRODING - CONTINUED

Cause	Special Instructions
No power to MerCathode controller.	Connect positive (+) lead of volt meter (set on 0-20 volt scale) to positive (+) terminal on the controller and negative (-) volt meter lead to negative (-) terminal. Meter should indicate battery voltage. Check for blown fuse (if equipped) on a standard MerCathode system. Clean the connection or repair wiring as required.
MerCathode system not functioning	Check the fuse in the hot lead.
	Check battery.
	Check for loose connections at controller and battery
	Check the grounding wire between the drive and the controller.

Corrosion On Underwater Parts, With MerCathode Or Impressed Current Protection

DRIVE OVER-PROTECTED

Cause	Special Instructions
Faulty MerCathode reference electrode.	Disconnect reference electrode lead (BRN) from “R” terminal on controller. Connect the lead to the positive (+) terminal of a digital multimeter (set on 0-2000 millivolt scale). Connect the negative (-) meter lead to the negative (-) battery terminal. Note the meter reading; then repeat the test with a test silver/silver chloride reference electrode held behind the drive. The same reading should be obtained in both cases. If not, replace the reference electrode.
Faulty MerCathode controller.	Check controller output. If the hull potential indicates overprotection, remove the reference electrode lead from the controller. If the controller is off (no impressed current called for) the voltage between the negative (BLK) and the anode should be less than 1 volt. Measure amperage; with the reference electrode disconnected, the amperage between the negative on the controller and the anode terminal should be less than 1 milli-amp. Replace the controller if needed.
Stray current corrosion (electrical current leaves a metal conductor and creates a path through the water).	Disconnect electrical components one at a time and observe the multimeter reading until you eliminate the high reading. Correct the source of the stray current.
Poor connection between the MerCathode reference electrode lead (BRN) and the “R” terminal on the controller.	Clean and/or tighten the connection. Repair wiring as needed.
MerCathode system not functioning.	Check the fuse in the hot lead.
	Check the battery.
	Check for loose connections at controller and battery.
	Check the grounding wire between the sterndrive and the controller.

Testing Procedure for Corrosion Protection

1. Unplug shore power (if equipped).
2. Measure hull potential with silver/silver chloride reference electrode and digital volt/ohm meter.

READINGS

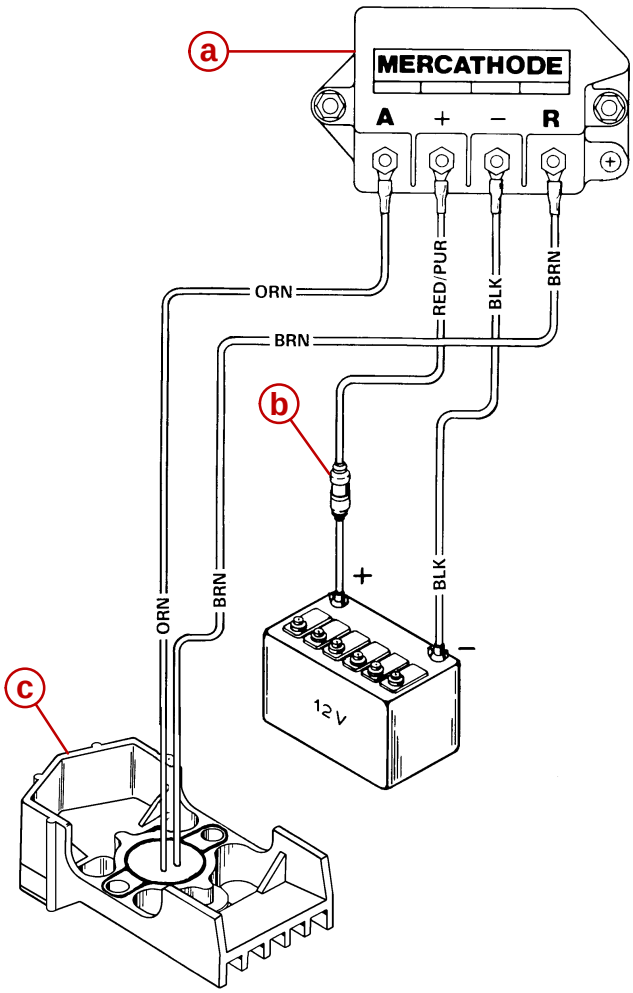
	Potential	Diagnosis
Saltwater	Below 850 millivolts	Drive is corroding. (Refer to “Drive Corroding”)
	Between 850 - 1100 millivolts	Drive is protected
	Above 1100 millivolts	Drive is overprotected. (Refer to “Drive Corroding”)

	Potential	Diagnosis
Freshwater	Below 750 millivolts	Drive is corroding. (Refer to “Drive Corroding”)
	Between 750 - 1050 millivolts	Drive is protected
	Above 1050 millivolts	Drive is overprotected. (Refer to “Drive Corroding”)

CORROSION SYMPTOMS

- Paint blistering (usually on sharp edges)
- Loosely adhering white corrosion products on exposed aluminum surfaces (do not confuse these with tenaciously clinging calcium carbonate deposits)
- Aluminum pitting

MerCathode Controller



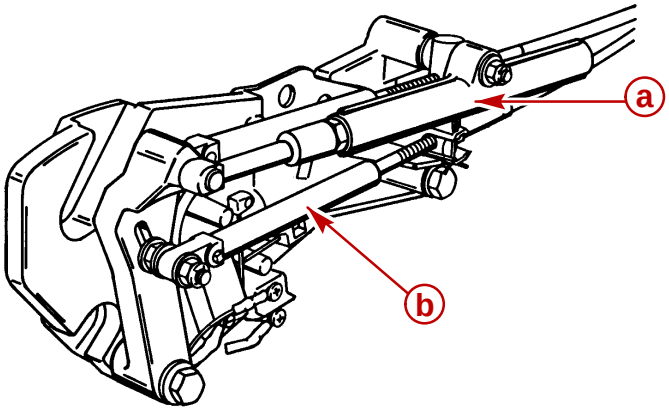
BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LIT = Light
DRK = Dark

73596

a - Controller
b - 20 Amp Fuse
c - Electrode

Shift System Troubleshooting

NOTE:*Some models may be equipped with a shift assist assembly. The only difference with these models is that the remote control shift cable attaching hardware is slightly longer. Shift cable adjustment is the same as all other versions.*

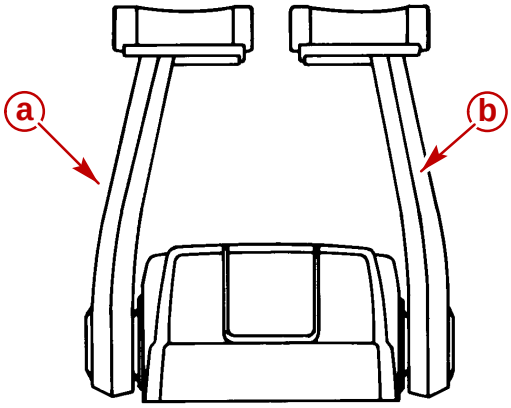


50308

a - Shift Assist Assembly
b - Remote Control Shift Cable

⚠ CAUTION

If the boat is equipped with A REMOTE CONTROL THAT HAS SEPARATE SHIFT AND THROTTLE LEVERS, this shift assist assembly should NOT be used. The use of the shift assist assembly with this type of remote control can cause the shift lever to move out of gear unexpectedly.



23159

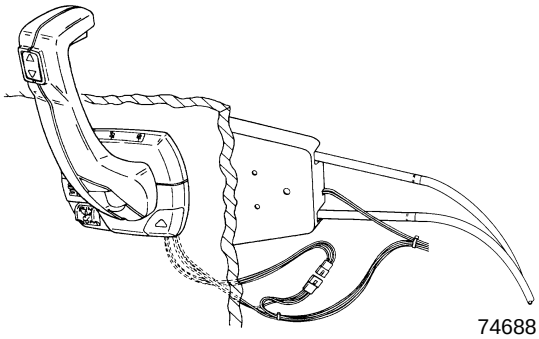
a - Shift Lever
b - Throttle Lever

Troubleshooting Shift Problems

NOTE:*The following information is provided to assist an installer in troubleshooting if hard shifting or chucking/racheting is encountered when shifting into forward gear.*

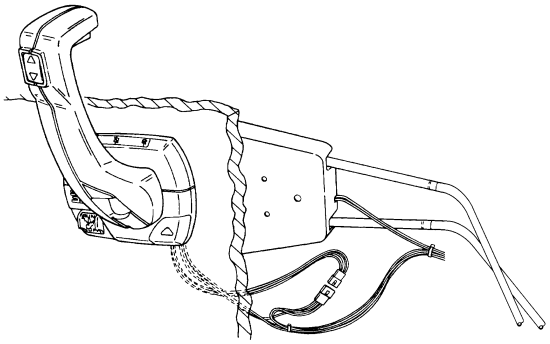
1. When installing the control box in the side panel of the boat, make sure that the cables have enough clearance to operate. This is necessary because the cables move up and down when the shift handle is moved. If the control box is mounted too far back toward any fiberglass structure, the cables will be interfered with. This will cause very hard shifting.

NOTE:*The control box housing can be rotated in 30° increments to improve cable routing.*



74688

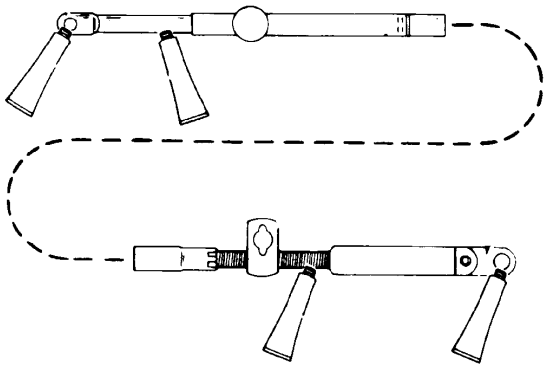
Proper Cable Bend



74689

Improper Cable Bend

2. Make sure that when the shift cable from the control box is led through the side gunnel of the hull, it does not have any extremely sharp bends in it as this will cause the stiff shifting.
3. Before installing the shift cable into the control box, extend the stainless rod eye end of the cable and grease it with 2-4-C Marine Lubricant with Teflon. Move it back and forth to allow even distribution of the grease.

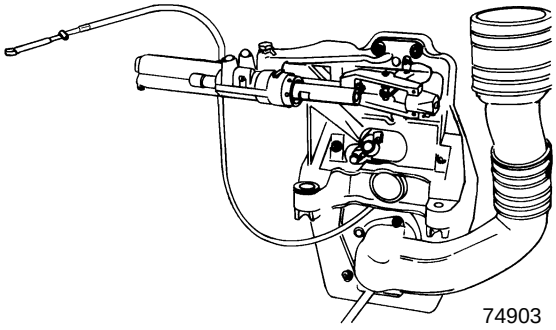


22005

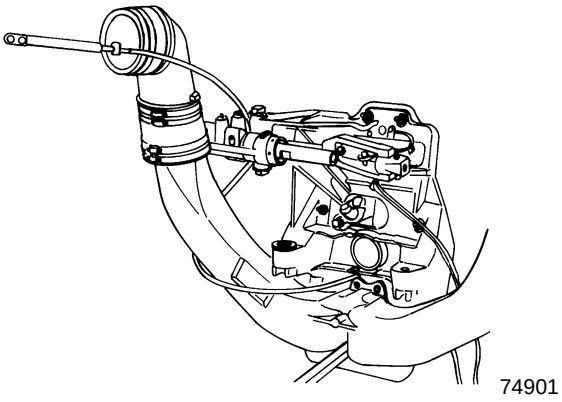
4. Do not strap or clamp the control cables to any other cables or rigid structure within **3 ft. (914 mm)** of the control box.
5. Be sure the cable is not permanently kinked.
6. Make sure there is proper clearance for cable movement when the control box is installed in the side panel. The cables must have room to move up and down when the control handle is shifted into either forward or reverse.
7. Ensure that the engine was not set down on the intermediate shift cable during installation, as this will crush the inner cable tubing and cause improper and/or stiff shifting.

8. DO NOT fasten the shift cable with straps or clamps to any other cable within **5 ft. (1524 mm)** of the shift plate.
9. DO NOT fasten the shift cable to the transom with any type of plastic clips or fasteners within **5 ft. (1524 mm)** of the shift plate.
10. DO NOT over tighten the throttle or shift cable attaching nuts at the engine end. Barrel and cable end must be free to rotate on the mounting stud.
11. Check the intermediate shift cable routing from the transom assembly to the shift plate as follows:
    a. The cable should come through the transom, above the exhaust pipe and make a turn toward the starboard side of the boat between the exhaust pipe and the engine flywheel housing.
    b. The cable should then be routed under the starboard rear engine mount and turned toward the transom.
    c. Then route the cable behind the power steering valve and loop over to the shift plate on the engine. Connect it to the anchor points on the shift plate.

Following this routing will prevent the engine coupler from damaging the cable.



4 Cylinder Inline Model



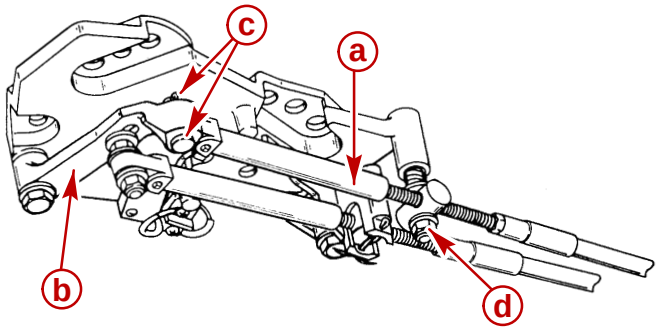
V6 and V8 Models

Checking for Excessive Play

Checking for excessive play in the drive unit shift system can be done with the boat in the water or on land. Refer to the appropriate procedure:

BOAT OUT OF WATER (ENGINE OFF)

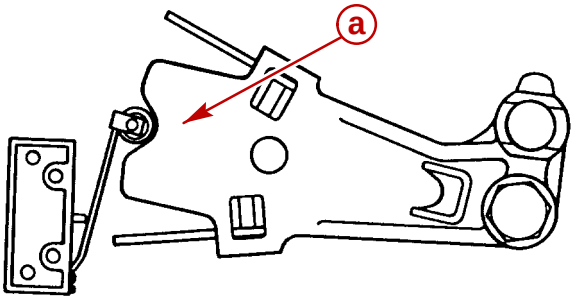
1. Disconnect remote control shift cable.



22267

a - Remote Control Shift Cable
b - Plastic Shift Lever
c - Clevis Pin and Cotter Pin
d - Locknut and Washer

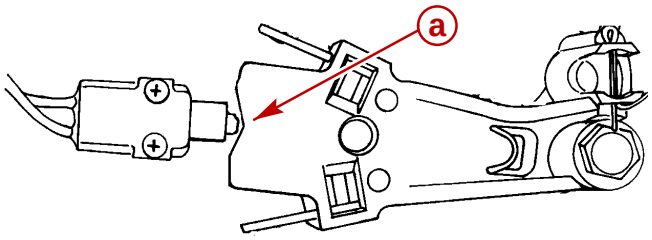
IMPORTANT: When pushing or pulling on drive unit shift cable in the following steps, apply just enough pressure so that V-notch starts moving. Then ease up slightly. Use a fine tip marking device to mark threaded tube to obtain an accurate measurement.



22058

Roller Type Switch

a - V-notch



75225

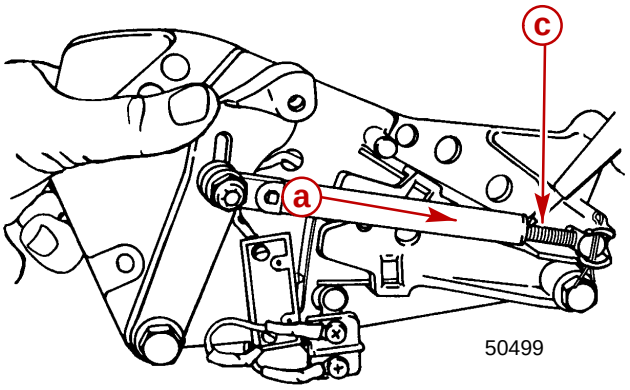
Plunger Type Switch

a - V-notch

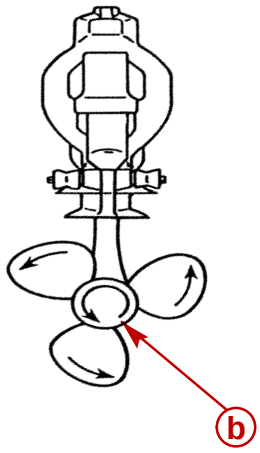
2. Check for excessive play in drive unit shift system:

a. Place drive unit into gear by pushing in on drive unit shift cable while rotating propeller shaft counterclockwise until it stops to ensure full clutch engagement.

b. Place a mark on shift cable threaded tube against edge of end guide.



50499

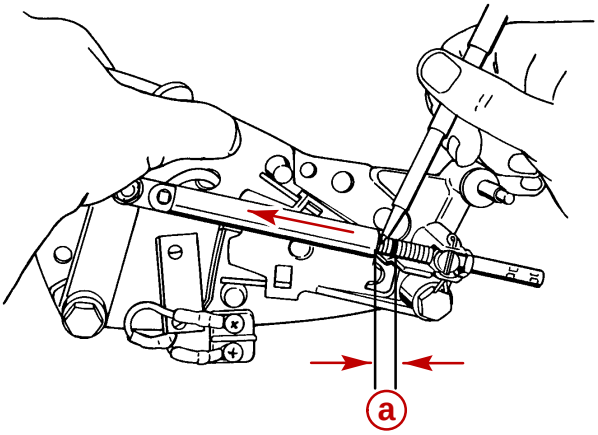


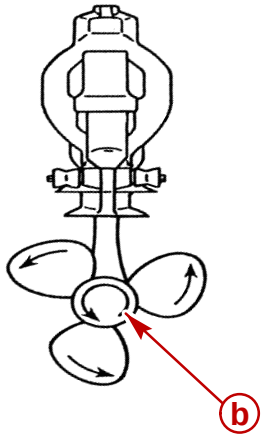
22266

a - Drive Unit Shift Cable
b - Propeller Shaft - Rotate
c - Threaded Tube - Mark Here

c. While maintaining pressure on propeller shaft in a counterclockwise direction (to keep clutch locked with gear), lightly pull out on drive unit shift cable end guide and place another mark on threaded tube.

d. Measure distance between both marks. Distance should be **9/16 in. (14 mm) or less**.





22266

a - 9/16 in. (14 mm) Or Less
b - Propeller Shaft - Maintain Pressure

If play is 9/16 in (14 mm) or less: No further attention to drive unit is needed. Proceed with adjustments.

If play is more than 9/16 in. (14 mm): Drive unit must be removed to further isolate excessive play.

BOAT IN WATER (ENGINE RUNNING)

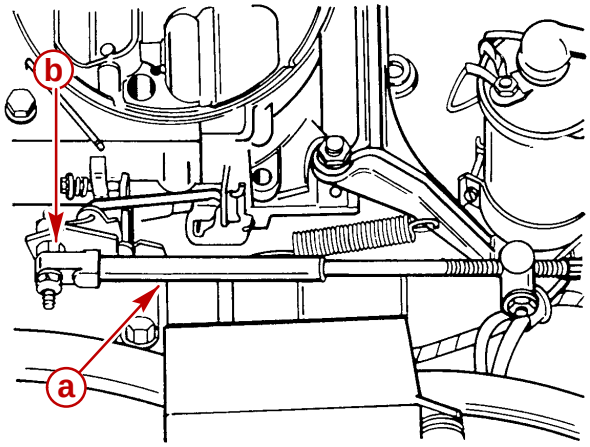
⚠ WARNING

At least two people will be needed for the following procedure, one person to check the adjustment and one person to stay at the control station of the boat.

⚠ WARNING

Ensure boat is secured to dock and precautions have been taken to avoid damage to boat prior to placing drive unit into gear.

1. Start engine and let it warm up to normal operating temperature (Refer to operating procedures in Operation and Maintenance Manual).
2. Disconnect throttle cable.

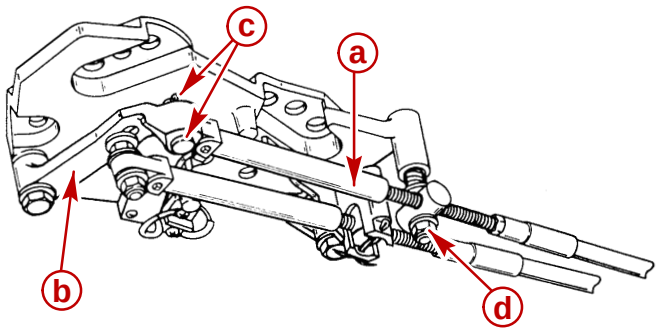


22062

Carburetor Model Shown (Others Similar)

a - Throttle Cable End Guide
b - Carburetor Throttle Lever

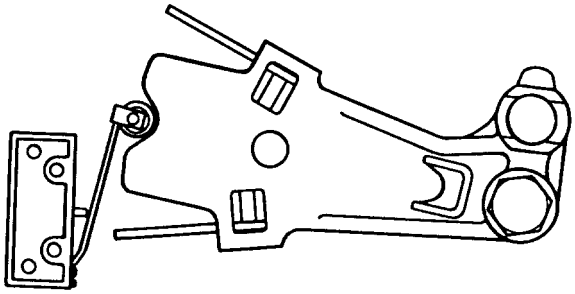
3. Disconnect Remote Control Shift Cable.



22267

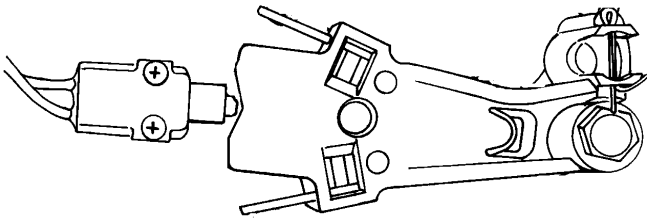
a - Remote Control Shift Cable
b - Plastic Shift Lever
c - Clevis Pin And Cotter Pin
d - Locknut And Washer

IMPORTANT: When pushing or pulling on drive unit shift cable, in the following steps, apply just enough pressure so that V-notch moves; then ease up slightly. Use a fine tip marking device to mark threaded tube to obtain an accurate measurement.



22058

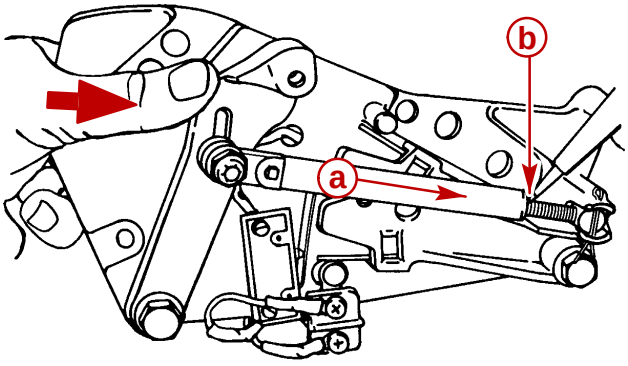
Roller Type Switch



75225

Plunger Type Switch

4. Check for excessive play in drive unit shift system as follows:
   a. Push in on drive unit shift cable.
   b. Place a mark on shift cable threaded tube against cable end guide.

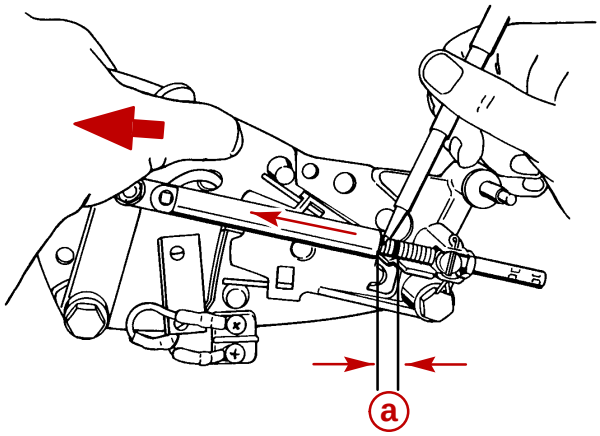


50499

a - Drive Unit Shaft Cable
b - Threaded Tube

   c. Lightly pull on drive unit shift cable end guide and place another mark on threaded tube.

d. Measure distance between both marks. Distance should be **9/16 in. (14 mm) or less.**



50497

a - 9/16 in (14 mm) Or Less

If play is 9/16 in. (14 mm) or less: No further attention to drive unit is needed. Proceed with adjustments.

If play is more than 9/16 in. (14 mm): Drive unit must removed to further isolate excessive play.

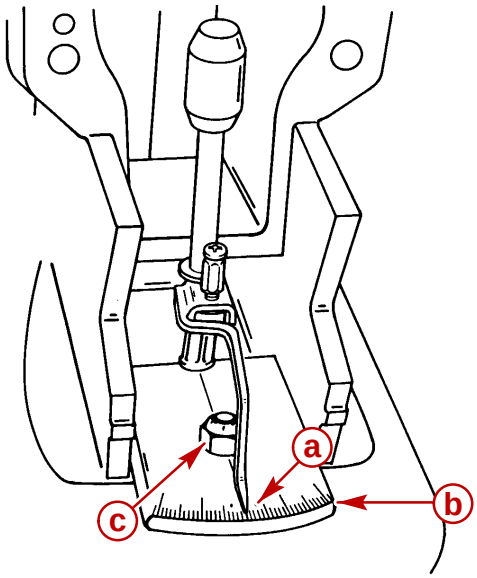
Isolating Excessive Play

NOTE:*Refer to the end of this section for templates and patterns needed to fabricate similar tools.*

1. To determine shift shaft rotational end play, use a tool such as the one shown, to measure degrees of play in the shift shaft, with clutch locked and held in gear.

NOTE:*Tool pattern on p. 1C - 45.*

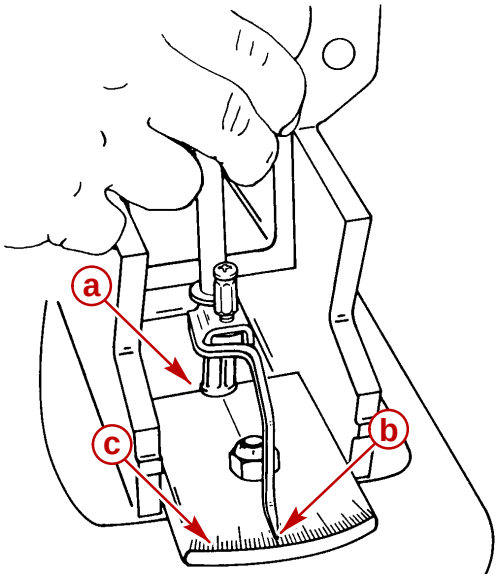
a. While maintaining pressure on propeller shaft to keep clutch locked with gear, lightly turn shift shaft coupler counterclockwise. Make note of pointer location.



50498

a - Pointer - Installed on Shift Shaft
b - Scale (1° Increments)
c - Nut - Hand Tight Only

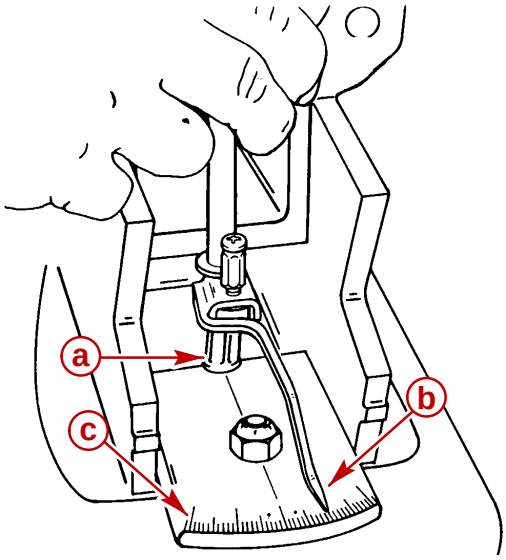
b. Rotate shift shaft coupler clockwise while simultaneously turning propeller shaft counterclockwise until clutch locks into gear. Make note of pointer location on scale.



50498

a - Shift Shaft Coupler
b - Pointer
c - Scale

c. While maintaining pressure on propeller shaft to keep clutch locked with gear, lightly turn shift shaft coupler counterclockwise. Make note of pointer location.



50498

a - Shift Shaft Coupler
b - Pointer
c - Scale

d. Determine total degrees of movement.

If 12° or less: problem is with the drive unit shift cable, upper shift shaft assembly and lever assembly.

If more then 12°: problem is with gear case shift spool assembly.

Whichever the case, refer to appropriate section for repair of applicable components.

Checking Remote Control Shift Cable Output

IMPORTANT: Remote control must provide a shift cable travel (at the shift plate end) of 2-7/8 in. (73 mm) to 3-1/8 in. (80 mm) with a 15-20 lb. (6.8-9 kg) load applied to the cable end guide.

Models With Shift Assist: This measurement can be taken by installing the remote control shift cable and using the shift assist assembly (provided) to place the proper load on the shift cable (drive unit shift cable should not be installed).

Models Without Shift Assist: This measurement can be taken by lightly pushing and pulling on the remote guide, to place the proper load, [15-20 lb. (6.8-9Kg)], on the shift cable.

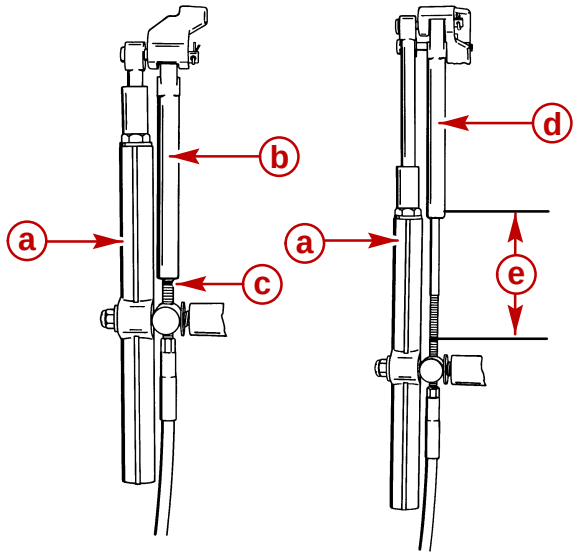
1. Place remote control into gear:

Right Hand Rotation Drive Unit - Forward gear wide-open-throttle position.

Left Hand Rotation Drive Unit - Reverse gear wide-open-throttle position.

Place a mark on threaded tube against edge of cable end guide.

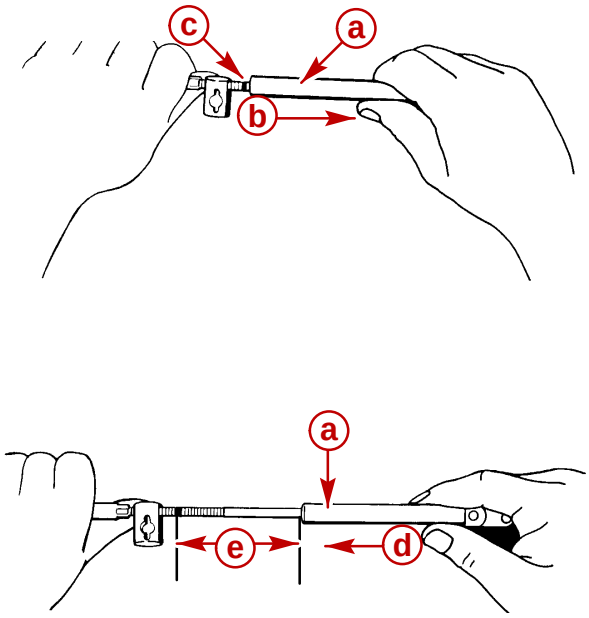
2. Place remote control into the opposite gear. Measure the distance between the edge of the shift cable end guide and the mark line in step 1. Total shift cable output must not be less than 2-7/8 in. (73 mm) or more than 3-1/8 (80 mm). If output is incorrect, remote control and/or shift cable must be replaced.



50368

With Shift Assist Assembly

- **a -** Shift Assist Assembly
- **b -** Remote Control Shift Cable - Retracted
- **c -** Place a Mark On Tube Against Edge Of Cable End Guide
- **d -** Remote Control Shift Cable - Extended
- **e -** Measurement Taken from Mark To Edge Of Cable End Guide: **2-7/8 in. (73 mm) To 3-1/8 in. (80 mm)**



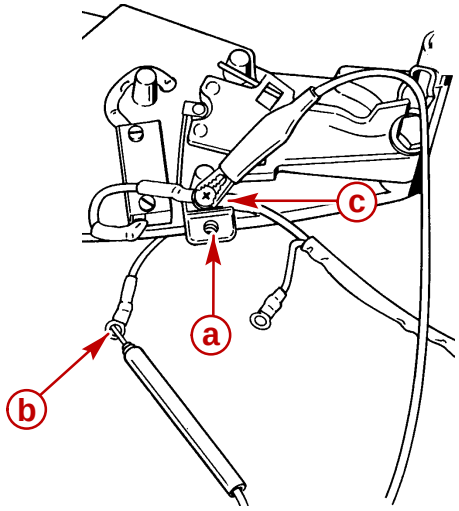
50499

Without Shift Assist Assembly

- **a** - Shift Cable end Guide
- **b** - Remote Control Shift Cable - Lightly Pull On End Guide
- **c** - Place A Mark On Tube Against Edge Of Cable End Guide
- **d** - Remote Control Shift Cable - Lightly Push In On End Guide
- **e** - Measurement Taken From Mark To Edge Of Cable End Guide **2-7/8 in. (73 mm) to 3-1/8 in. (80 mm)**

Checking Cutout Switch Timing (Models With Roller Type Switch)

1. Disconnect Cutout Switch WHITE/GREEN wire from terminal block or bullet conector.
2. Connect ohmmeter positive (+) lead to cutout switch WHITE/GREEN wire and ohmmeter negative (–) lead to cutout switch black wire at terminal block.
3. Set Ohmmeter on Rx1 scale.

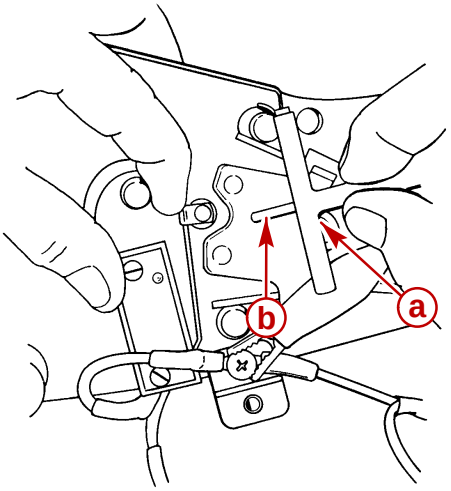


50497

- **a** - Terminal Block
- **b** - Cutout Switch WHITE/GREEN Wire
- **c** - Cutout Switch BLACK Wire

NOTE:*Refer to the end of this section for the pattern and dimensions needed to fabricate a similar tool.*

Slowly move cutout switch roller off of its seat. Circuit should close (full continuity reading) when roller is moved 1/8 in. (3 mm). Use the 1/8 in. rod on the end of special tool to gauge this movement.

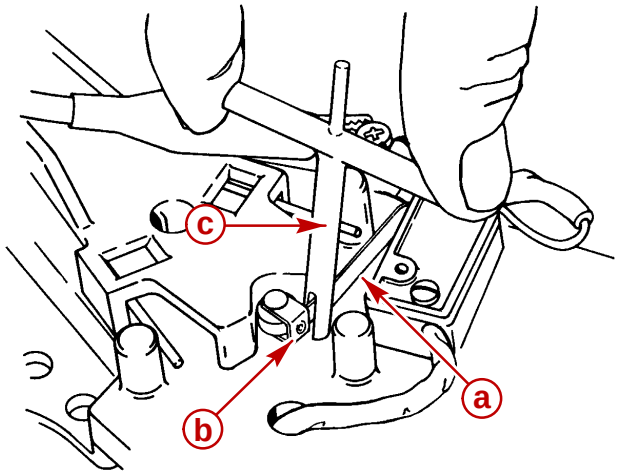


50497

a - Special Tool
b - 1/8 in. (3 mm)

If switch closes too early (less than 1/8 in.): Roller must be bent away from its seat.

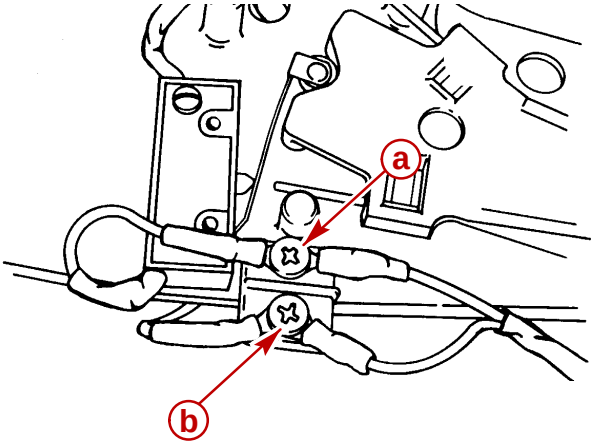
If switch closes too late (more than 1/8 in.): Roller must be bent toward its seat.



50499

a - Lever
b - Roller
c - Special Tool

4. Once cutout switch is timed properly, reconnect wires at terminal block and coat terminals with Liquid Neoprene.

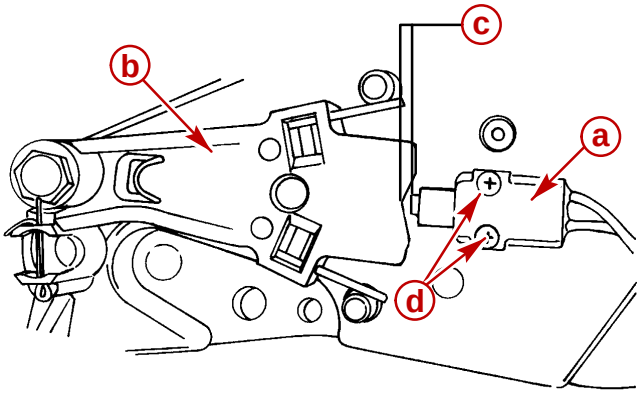


50499

a - BLACK Wires
b - WHITE/GREEN Wires

Checking Cutout Switch Timing (Models With Plunger Type Switch)

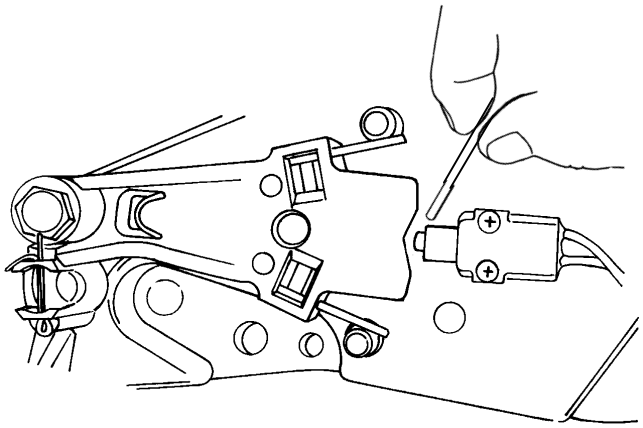
1. While holding the retainer nuts on the back of the shift plate, loosen the two phillips head screws on the shift cutoff switch and slowly move the switch either forward or aft.



75225

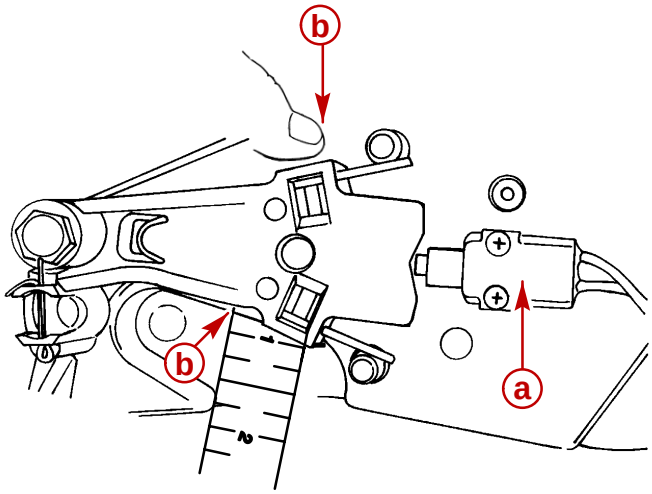
a - Switch/Plunger Pin
b - Activating Lever Assembly
c - 1/32'in. (0.8 mm) Adjustment
d - Two Screws

2. Adjust switch to locate plunger pin to 1/32 in (0.8 mm). between plunger pin and activating lever assembly.



75679

3. Slowly move activating lever assembly off until cutout switch opens or closes. Circuit should open or close when the activating lever assembly is moved 3/16 +/– 1/32 in. (4.8 +/– 0.8 mm).



75225

a - Cutout Switch
b - Movement of Activating Lever Assembly

4. After adjustments are made and are within 3/16 +/– 1/32 in. (4.8 +/– 0.8 mm), tighten the screws on the cutout switch. After tightening screws, recheck the plunger pin position.

Checking Operation

1. Reconnect throttle cable.
2. Place boat in water and start engine. Check the following:
   a. Shift into forward and reverse gear, verify clutch engages before engine begins to accelerate.
   b. Accelerate engine in forward and reverse gear to ensure engine does not shut down.
   c. Check that shift cutout switch roller is centered in notch of shift cutout lever, with drive unit in forward and reverse gear.
   d. Shift from IN gear position to neutral, ensure drive unit is in neutral before remote control shift lever comes to neutral detent position.

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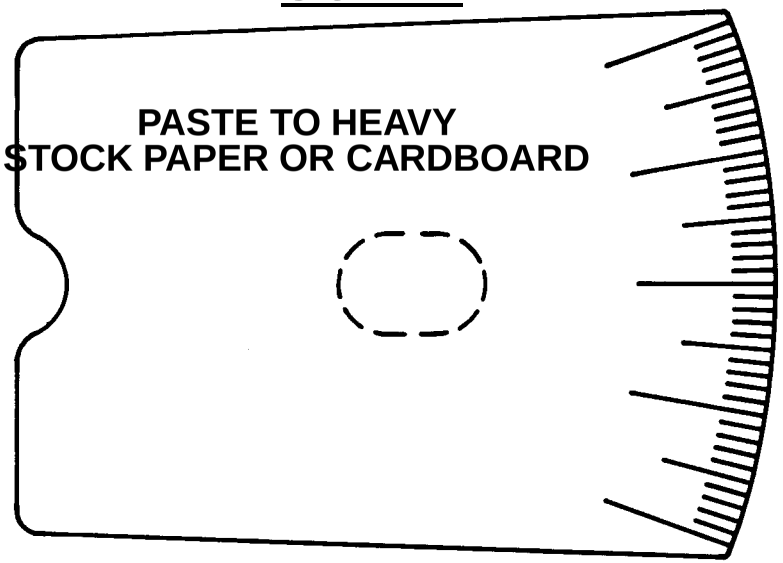
SCALE



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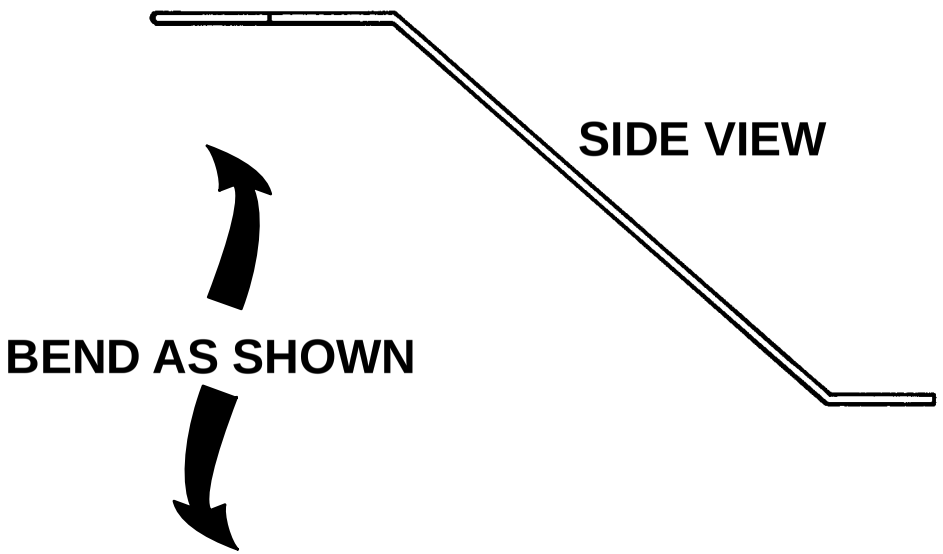
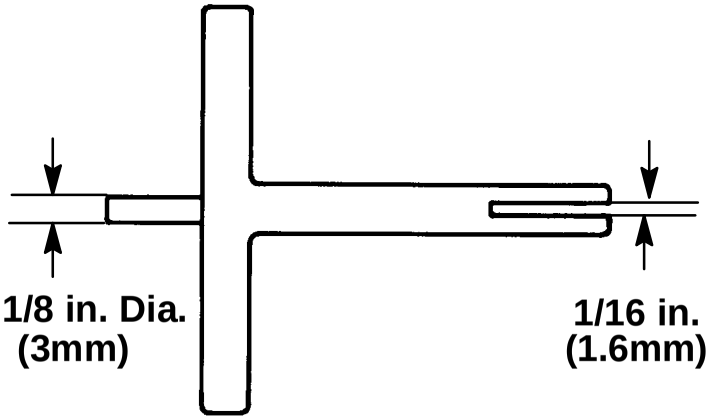
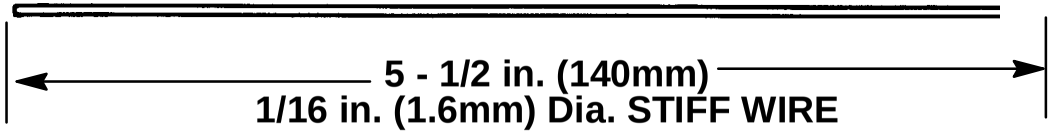


CUTOUT SWITCH ADJUSTMENT TOOL

50375





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REMOVAL, INSTALLATION AND ADJUSTMENT

Section 2A - All Models

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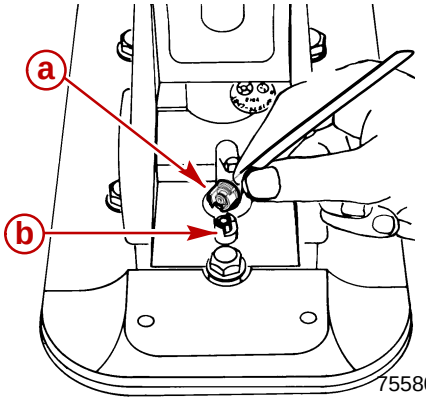
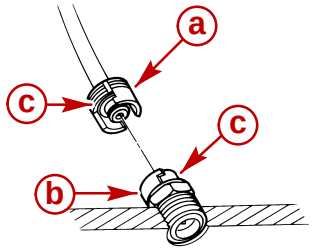
Sterndrive Unit Removal

1. Move remote control shift lever into the FORWARD gear position on standard rotation gear cases, or REVERSE on counter rotation gear cases.
2. Press trailer button on control handle to raise drive unit to trailer position / full-up position.
3. Raise the drive unit to gain access to area between gimbal housing and sterndrive immediately atop the transom end of the anti-ventilation plate.
4. Disconnect speedometer fittings following a. or b. as appropriate:
   a. Grasp the top half of the plastic fitting, turn counterclockwise and pull up to disengage locking device.



75580

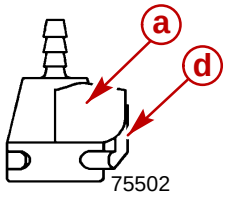


70025

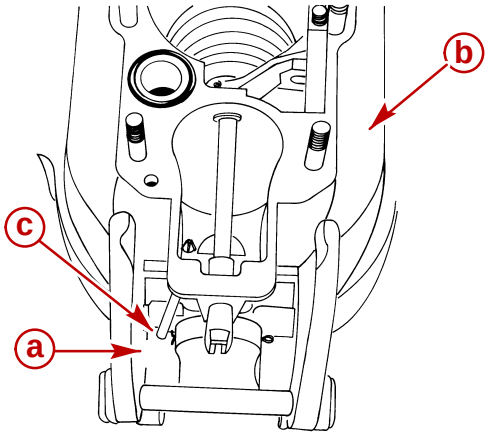
1997-1/2 and Earlier Model Speedometer Connector

a - Speedometer Connector, Male End
b - Speedometer Connector, Female End
c - Alignment Slots

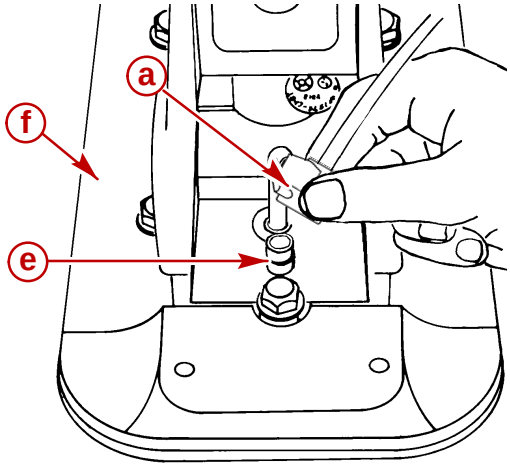
b. Push in on the release button on the female end of the speedometer connector. Pull to remove.



75502



75581



75513

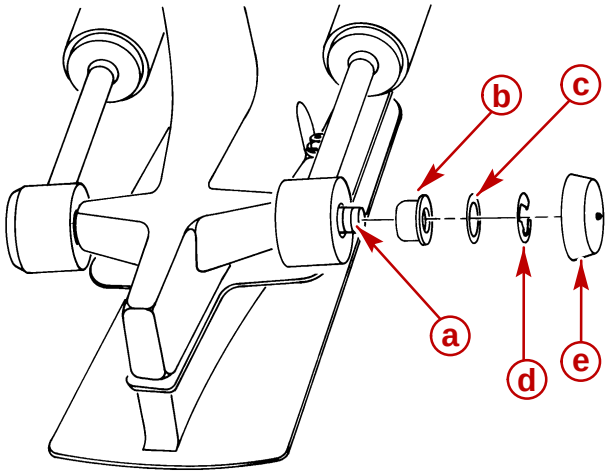
1998 and Later Model Speedometer Connector

- **a** - Speedometer Connector, Female End
- **b** - Bell Housing
- **c** - Sta-Strap
- **d** - Release Button
- **e** - Speedometer Connector, Male End
- **f** - Drive Unit

IMPORTANT: When lifting drive with other than hydraulic system, secure the drive unit with a suitable lifting device so that the drive unit will not fall.

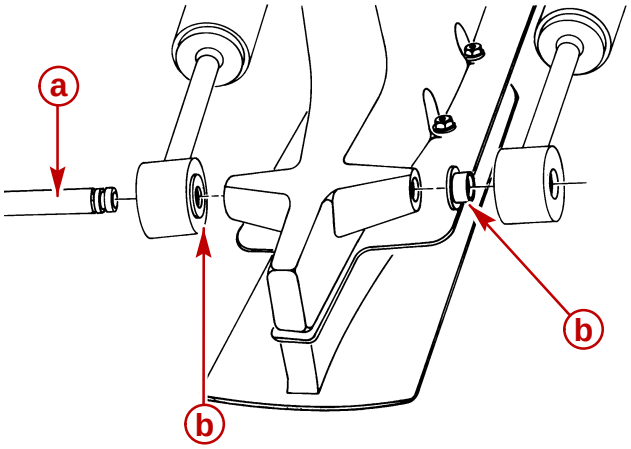
5. Lower drive unit to full IN/DOWN position.

6. Remove power trim cylinders (aft end) from drive unit.



70027

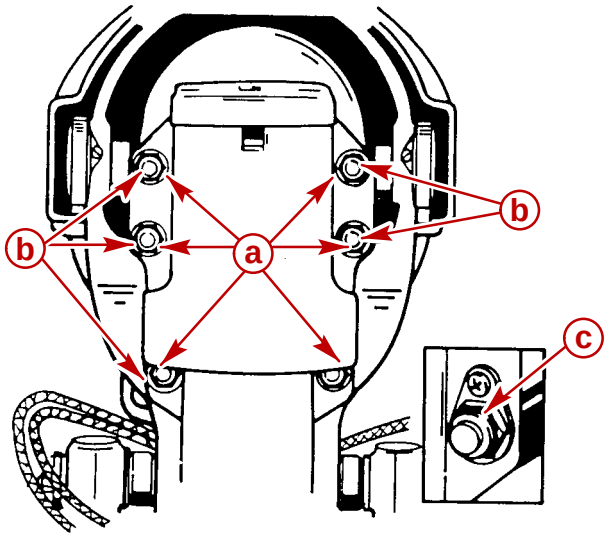
a - Aft Anchor Pin
b - Bushings (4)
c - Flat Washers (2)
d - E-ring Clips (2)
e - Plastic Caps (2)



70026

a - Aft Anchor Pin
b - Bushings

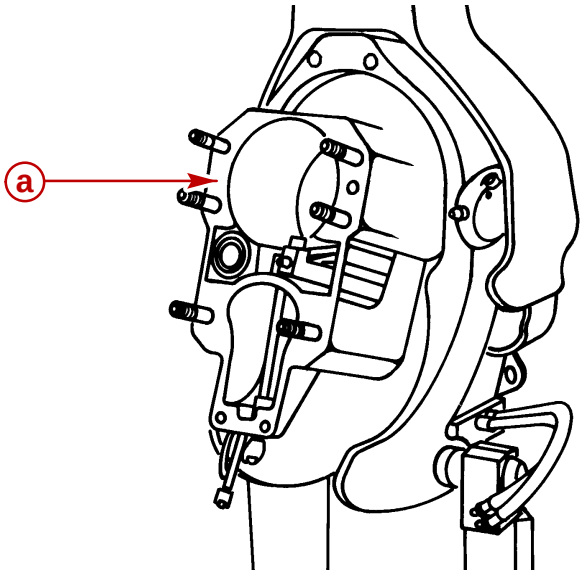
7. Remove the 6 locknuts and 5 washers that hold the drive unit to the transom unit and remove sterndrive unit.



22062

a - Locknuts (6)
b - Washers (5)
c - Ground Plate

8. Remove bell housing gasket.



70085

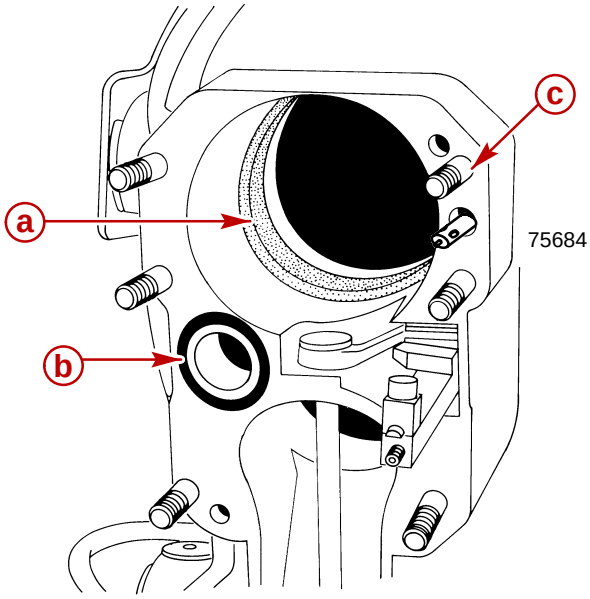
a - Bell Housing Gasket

Sterndrive Unit Installation

1. Install and align engine. Refer to appropriate engine service manual.

IMPORTANT: Rubber gasket must be properly positioned and glued in bell housing bore before installing drive unit or water may leak into boat.

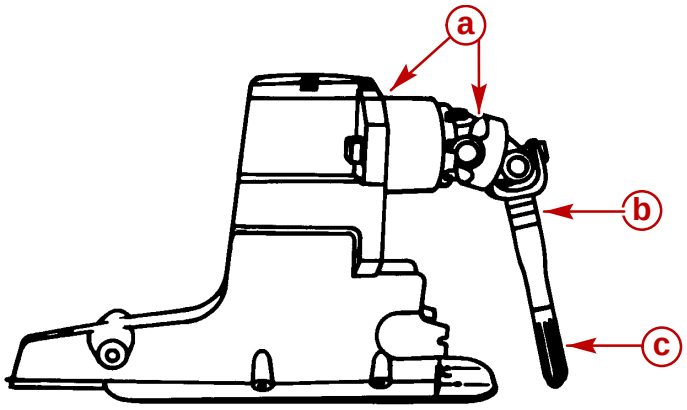
2. Ensure that rubber gasket and water passage O-ring are properly positioned in bell housing.
3. Coat entire stud and threads with 2-4-C Marine Lubricant with Teflon.



70022

a - Rubber Gasket
b - Water Passage O-ring
c - Studs

4. Coat drive unit pilot, U-joint shaft O-rings and U-joint shaft splines with Engine Coupler Spline Grease.

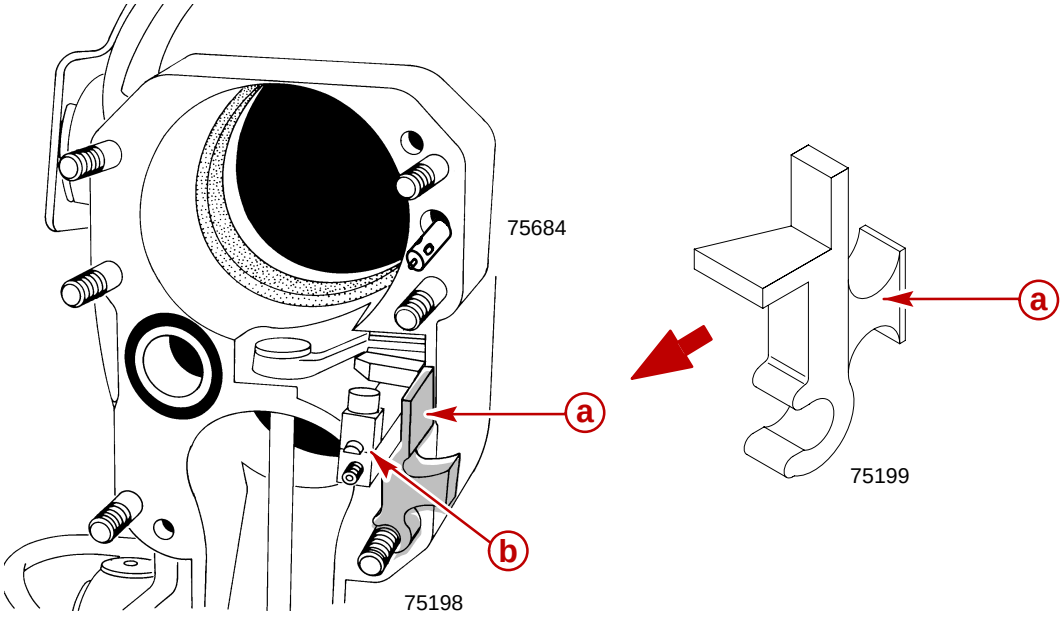


70114

a - Drive Unit Pilot
b - U-joint Shaft O-rings
c - U-joint Shaft Splines

5. Snap the Shift Slide Stabilizer Tool onto stud directly below shift slide and position as shown.

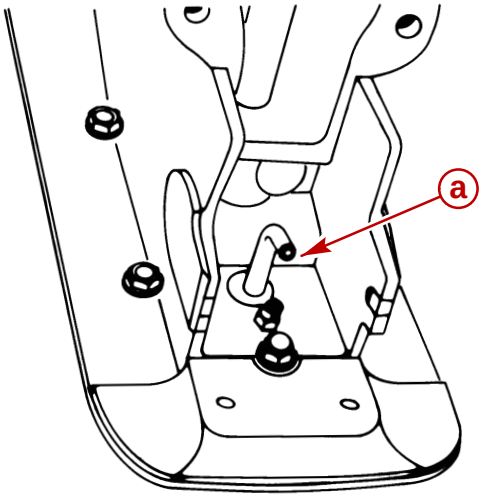
6. Position bell housing shift slide so that slot in intermediate shaft coupler is positioned straight fore and aft. Do this by placing remote control shift lever in: **FORWARD gear WOT position for RH drive** or **REVERSE gear position for LH drive unit.**



a - Shift Shaft Slide Stabilizer Tool
b - Shift Slide

IMPORTANT: Shift slide assembly is free to rotate on core wire. Therefore, be careful that shift slide remains in upright position and is properly engaged with shift shaft lever while installing drive unit.

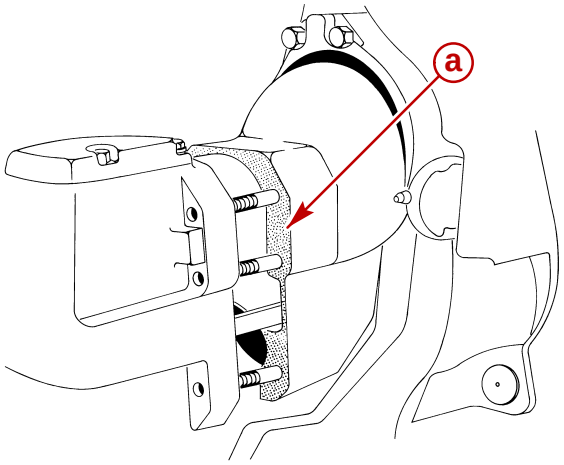
7. Position drive unit shift shaft so that is straight forward by turning shift shaft clockwise while simultaneously turning propeller shaft counterclockwise.



a - Drive Unit Shift Shaft Coupler

IMPORTANT: Be sure to install RH or LH drive unit on the appropriate transom assembly when making dual engine installations. The LH rotation drive unit can be identified by the decal on the back side of the upper drive shaft housing, which states: “Alpha One - Counter Rotation” or has an L on the propshaft

8. Place gasket on bell housing.



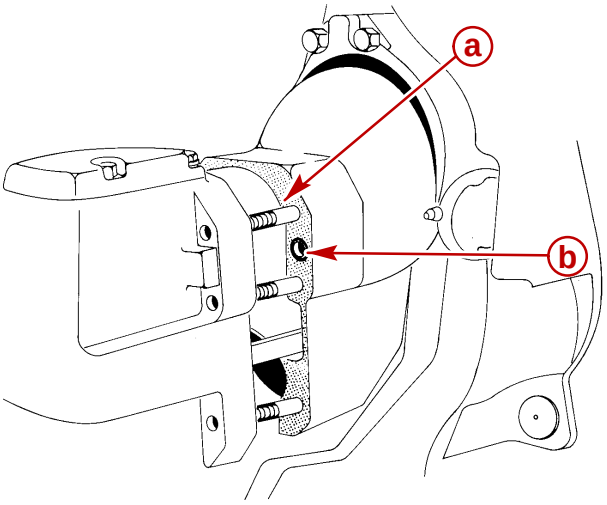
70048

Without Gear Lube Monitor

(Shown Without Shift Slide Stabilizer Tool For Visual Clarity)

a - Gasket

NOTE: *If equipped with Gear Lube Monitor BE SURE to install the gasket with the hole for oil passage.*



70048

With Gear Lube Monitor

(Shown Without Shift Slide Stabilizer Tool For Visual Clarity)

a - Gasket
b - Oil Passage Hole

9. Install sterndrive unit:

   a. Position trim cylinder straight back (over top of acceleration plate). Be careful not to scratch acceleration plate or trim cylinders.

   b. Guide U-joint shaft through gimbal bearing and into engine coupler while simultaneously guiding shift slide into drive shaft housing. Make sure shift slide remains upright and engaged with bell housing shift shaft lever.

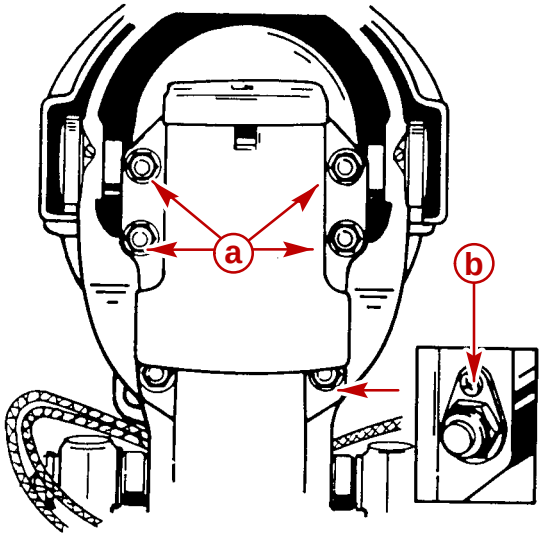
   c. After the U-joint shaft has begun to enter the engine coupler, remove the Shift Slide Stabilizer Tool.

d. Ensure that the stud is thoroughly coated with Quicksilver 2-4-C Marine Lubricant with Teflon.

IMPORTANT: If drive unit will not slide all the way into bell housing, ensure shift shaft couplers are positioned properly and all O-rings are greased. Do not force drive unit into position.

e. If necessary, rotate propeller shaft counterclockwise slightly to help align U-joint shaft splines with engine coupler splines. Then slide drive unit into bell housing.

10. Secure drive unit to bell housings using fasteners as shown. Torque to 50 lb-ft (68 N•m).



22062

a - Locknut and Flat Washers
b - Locknut and Continuity Circuit Washer (No Flat Washer at this Location)

11. Return remote control shift lever to the neutral position.

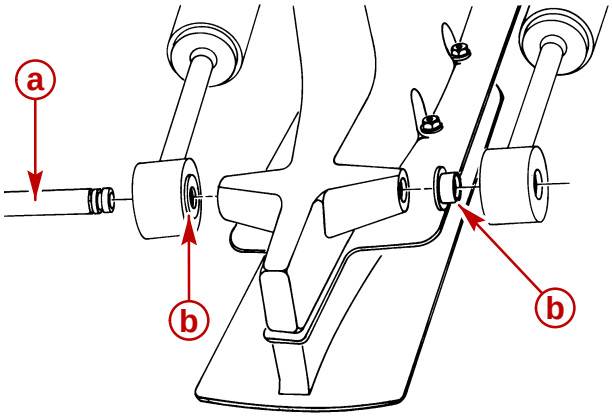
12. Install trim cylinders on aft end of drive unit with hardware as shown. Coat all components, except plastic caps, with Quicksilver Special Lube 101 upon installation. Push-fit plastic caps onto ends of aft anchor pins.

a. Insert one bushing in each inboard hole of both trim cylinders.

b. Align the bores of the trim cylinders with that of the drive unit.

c. Insert the aft anchor pin through one of the trim cylinders, the drive unit bore and then the other trim cylinder until it protrudes equally on both sides of the unit.

NOTE: *Distance between the trim cylinders and the drive unit anchor pin bore is exaggerated for visual clarity.*



70026

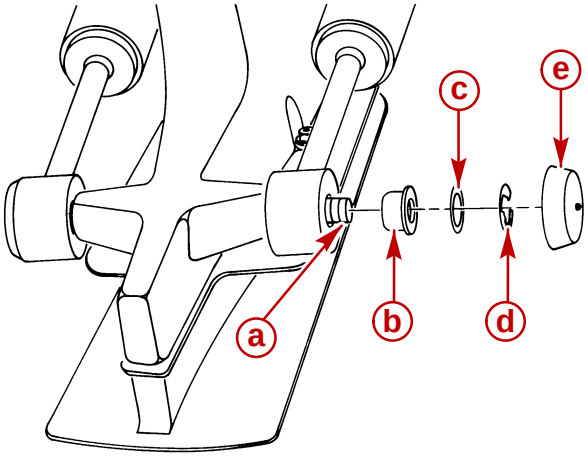
a - Aft Anchor Pin
b - Bushings

d. Install the two remaining bushings onto the aft anchor pin ends and fit into bore of trim cylinders.

e. Install the flat washers.

f. Install the E-ring clips.

NOTE: *The inboard grooves of the aft anchor pin are for E-ring clips, and wider, outboard grooves are for securing plastic caps.*



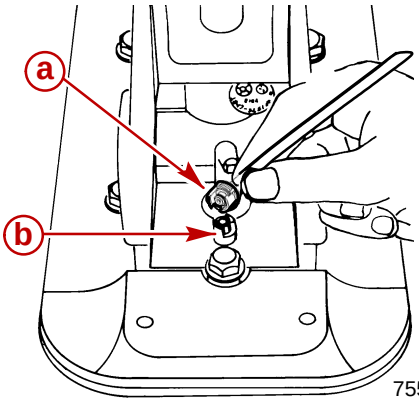
70027

a - Aft Anchor Pin
b - Bushings
c - Flat Washers (2)
d - E-ring Clips (2)
e - Plastic Caps (2)

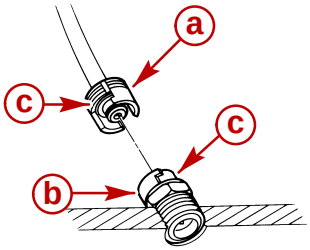
13. Raise drive to gain access to area between gimbal housing and sterndrive, immediately atop the transom end of the anti-ventilation plate.

14. Connect speedometer fittings following a. or b. as appropriate:

a. Align the plastic fittings, push down and turn clockwise to engage locking device.



75580

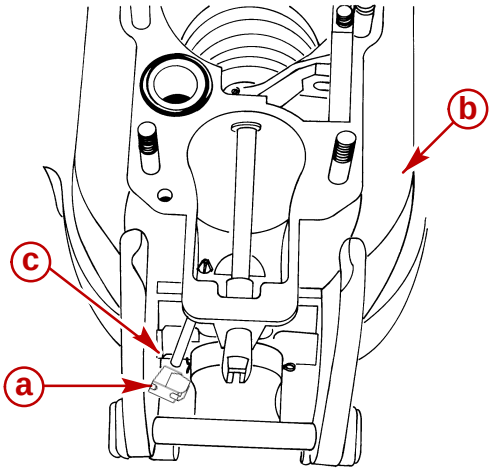


70025

1997-1/2 and Earlier Model Speedometer Connector

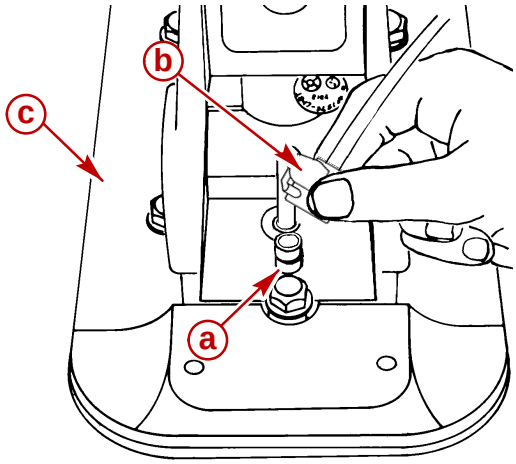
a - Male End Of Speedometer Fitting
b - Female End Of Speedometer Fitting
c - Alignment Slots

b. Push the release button and slide the female portion of the speedometer connector over the male portion.



75581

a - Speedometer Connector, Female End
b - Bell Housing
c - Sta-Strap



75513

1998 and Later Model Speedometer Connector

a - Speedometer Connector, Male End
b - Speedometer Connector, Female End
c - Gear Housing

Remote Control Shift Cable Adjustment (Drive Unit Installed)

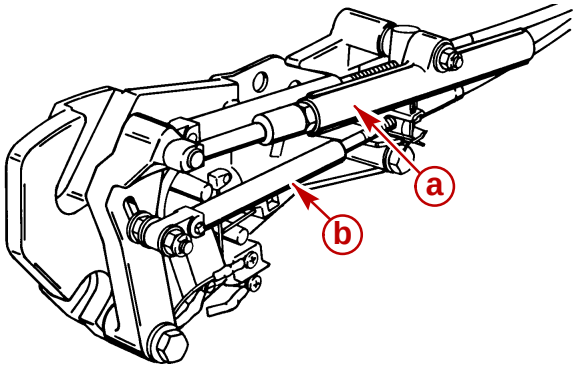
NOTE: *The illustrations on the following pages show models that have a shift plate that is mounted on the exhaust elbow. The shift mechanism components on the 3.0L model are located on the top of the valve cover or on the starboard harness bracket. The procedure for making the adjustments is the same.*

IMPORTANT: Shift cable adjustment for a right hand (RH) rotation drive unit is different than the procedure for adjusting a left hand (LH) rotation drive unit. Be sure to refer to the appropriate procedure when performing the following steps.

IMPORTANT: Drive unit must be installed.

IMPORTANT: DO NOT run engine.

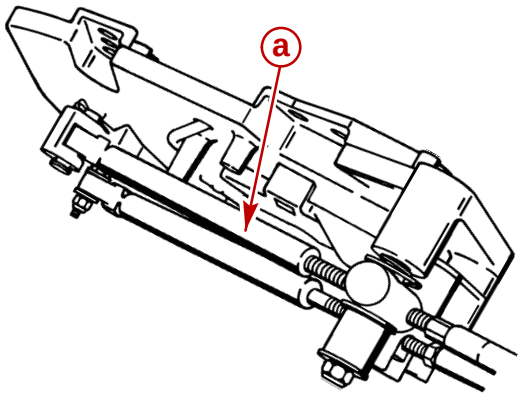
1. Remove remote control shift cable and shift assist assembly (if installed).



50308

With Shift Assist Assembly

a - Shift Assist Assembly
b - Remote Control Shift Cable

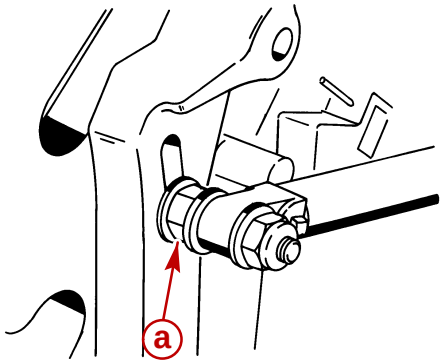


50310

Without Shift Assist Assembly

a - Remote Control Shift Cable

2. Ensure shift lever adjustable stud is located in the slot at the end closest to the shift lever pivot point. If necessary, loosen stud and align stud in the slot, then retighten stud.



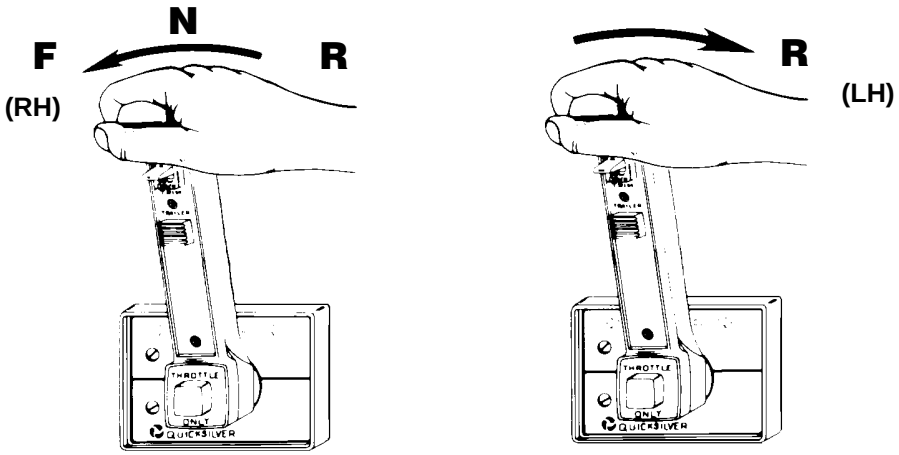
50309

a - Adjustable Stud

3. Shift remote control as stated in a. or b.:

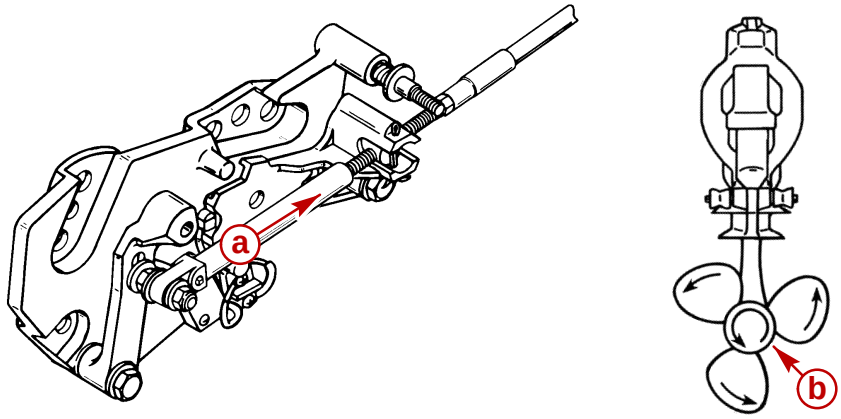
   a. **Right Hand (RH) Rotation Drive Unit -** forward gear, past detent, into wide-open-throttle position.

   b. **Left Hand (LH) Rotation Drive Unit -** reverse gear, past detent, into wide-open-throttle position.



4. Place drive unit into gear by pushing in on drive unit shift cable, while simultaneously rotating propeller shaft counterclockwise until shaft stops, to ensure full clutch engagement. Maintain a light pressure on the drive unit shift cable to hold it at the end of its travel (this removes all slack from the cable).

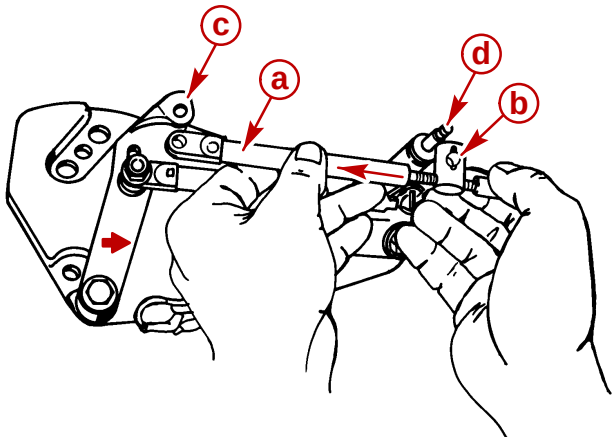
IMPORTANT: Do not use excessive force when holding pressure on the drive unit shift cable. Excessive force would be indicated by movement of the V-notch of the actuator lever assembly.



22266

a - Drive Unit Shift Cable - Push In
b - Propeller Shaft - Rotate Counterclockwise

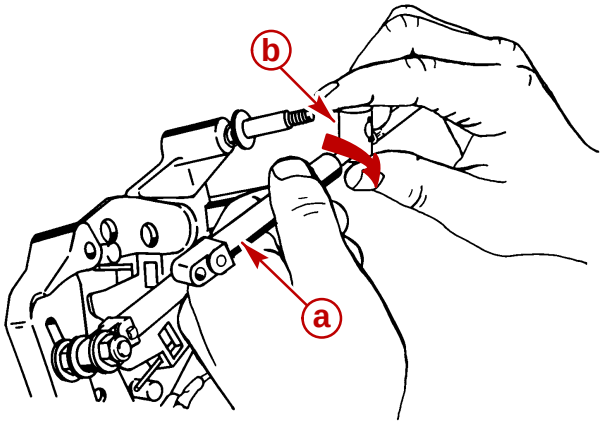
5. Lightly pull on remote control shift cable end guide (to remove slack from remote control and cable) and adjust brass barrel as necessary to align attaching points with shift lever clevis pin hole and stud. Be sure to maintain light pressure on drive unit shift cable.



50309

a - End Guide
b - Brass Barrel
c - Shift Lever Clevis Pin Hole
d - Stud

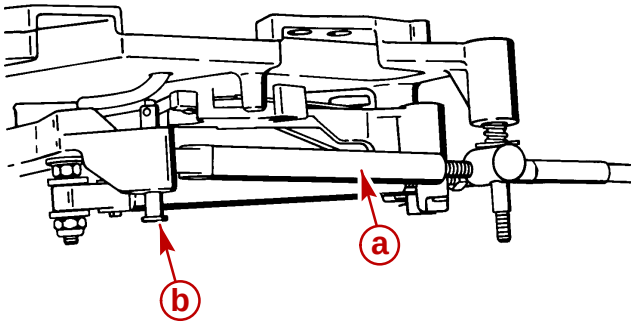
6. After cable has been aligned, turn brass barrel 4 turns **away** from cable end guide.



50308

e - End Guide
f - Brass Barrel

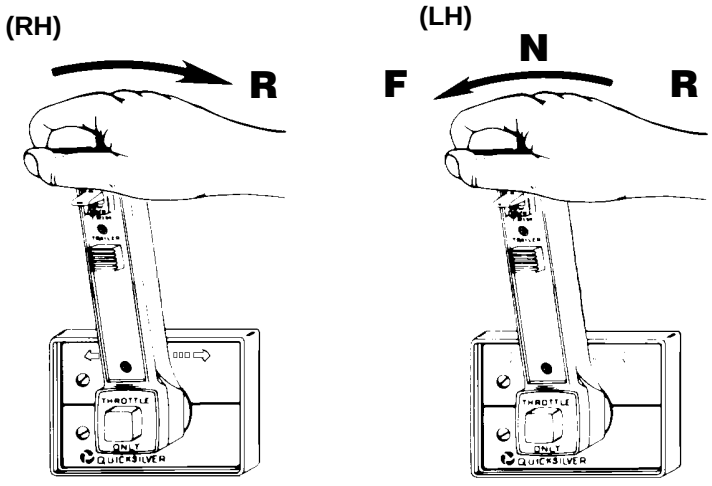
7. Temporarily install remote control shift cable on stud and install clevis pin.



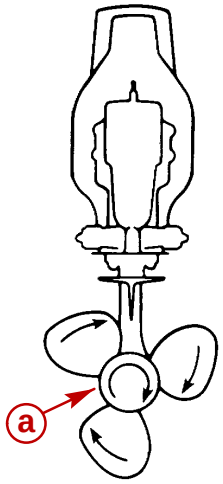
50308

a - Remote Control Shift Cable
b - Clevis Pin

8. Shift remote control as stated in a. or b. :
   a. **Right Hand (RH) Rotation Drive Unit -** reverse gear, past detent, into wide-open-throttle position.
   b. **Left Hand (LH) Rotation Drive Unit -** forward gear, past detent, into wide-open-throttle position.



9. Simultaneously rotate propeller shaft clockwise until shaft stops to ensure full clutch engagement.

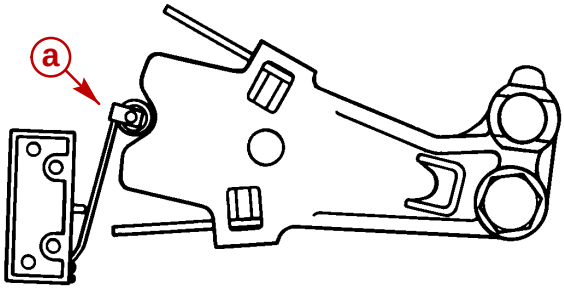


22267

a - Propeller Shaft - Rotate Clockwise

10. Perform a. or b. as appropriate:

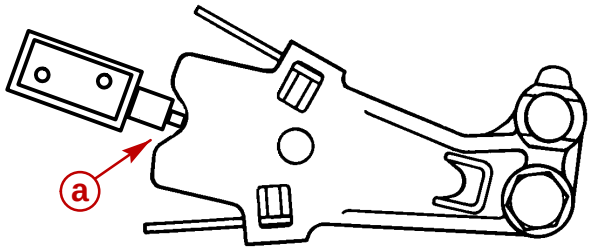
a. **On Models with Earlier Type Switch:** check shift cutout switch lever position. Roller must be centered.



22058

a - Shift Cutout Switch Roller

b. **On Models with Later Type Switch:** check shift cutout switch plunger position. Pin must be centered.



75128

a - Shift Cutout Switch Plunger

11. If roller or plunger pin is not centered:

a. Ensure adjustable stud is at bottom of slot in shift lever.

b. Check remote control for proper shift cable output [3 in. (76 mm) ± 1/8 in. (3 mm)].

c. If a and b are correct, ensure drive unit shift cable is not crushed or kinked. (If drive unit shift cable is binding, the shift cutout switch roller or plunger pin will move off center when shifting “into” and “out of” forward **and** reverse).

NOTE: *If shift cable was damaged during installation, install new shift cable assembly, then repeat shift cable adjustment procedure.*

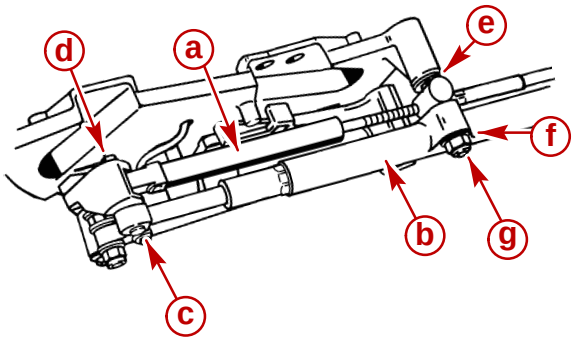
⚠ CAUTION

Improper installation of the shift assist assembly could result in damage or malfunction to the shift control box.

For Commander 3000 Controls, if shift assist assembly attaching points do not align, verify controller is in the neutral position. Remove the shift cable and reposition the adjustment barrel as required to allow the shift assembly to be installed with no effort.

For ALL other controls, if shift assist assembly attaching points do not align, push in or pull out on end of shift assist assembly to install. Do not attempt to readjust shift cable.

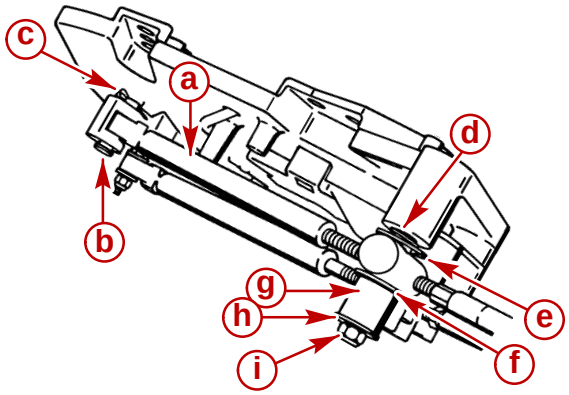
12. After remote control shift cable has been properly adjusted, reinstall cable and shift assist assembly (if applicable) and secure with hardware. Tighten locknut completely then back off 1/2 turn.



50308

With Shift Assist Assembly

- **a** - Remote Control Shift Cable
- **b** - Shift Assist Assembly
- **c** - Clevis Pin
- **d** - Cotter Pin
- **e** - Large I.D. Washer
- **f** - Small I.D. Washer
- **g** - Locknut



50310

Without Shift Assist Assembly

a - Remote Control Shift Cable
b - Clevis Pin
c - Cotter Pin
d - Spring
e - Washer
f - Washer
g - Spacer
h - Washer
i - Locknut

IMPORTANT: If an extra long remote control shift cable is used, or if there are a large number of bends in remote control shift cable, or remote control has inadequate output travel, an additional adjustment may be necessary. Refer to step 13 or 14 as applicable.

13. **Remote Control with Single Lever Shift/Throttle Control:**

a. **RIGHT HAND (RH) propeller rotation drive unit -** Shift remote control into reverse gear, wide-open-throttle position while simultaneously rotating propeller shaft clockwise. Clutch should engage and cause propeller shaft to lock. If clutch does not engage, loosen adjustable stud on shift lever and move it upward in slot until clutch engages with reverse gear. Retighten stud. Shift remote control several times and stop in reverse to recheck shift cutout switch position. Roller or pin must be centered.

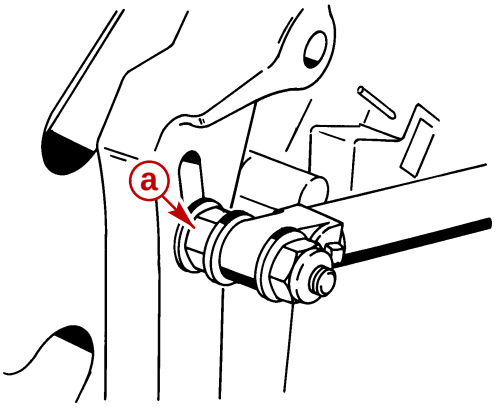
b. **LEFT HAND (LH) propeller rotation drive unit -** Shift remote control into forward gear, wide-open-throttle position while simultaneously rotating propeller shaft clockwise. Clutch should engage and cause propeller shaft to lock. If clutch does not engage, loosen adjustable stud on shift lever and move it upward in slot until clutch engages with forward gear. Retighten stud. Shift remote control several times and stop in forward to recheck shift cutout switch position. Roller or pin must be centered.

14. **Two Lever Remote Control with Separate Shift and Throttle Levers:**

a. **RIGHT HAND (RH) propeller rotation drive unit -** While turning propeller shaft clockwise, move remote control shift handle into full reverse position. Clutch should engage before shift lever comes to a stop. If clutch does not engage, loosen adjustable stud on shift lever and move it upward in slot until clutch engages with reverse gear. Retighten stud. Shift remote control several times and stop in reverse to recheck shift cutout switch position. Roller or pinmust be centered.

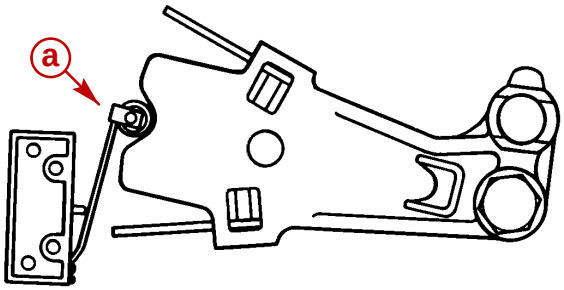
b. **LEFT HAND (LH) propeller rotation drive unit -** While turning propeller shaft clockwise, move remote control shift handle into full forward position. Clutch should

engage before shift lever comes to a stop. If clutch does not engage, loosen adjustable stud on shift lever and move it upward in slot until clutch engages with forward gear. Retighten stud. Shift remote control several times and stop in forward to recheck shift cutout switch position. Roller or pin must be centered.



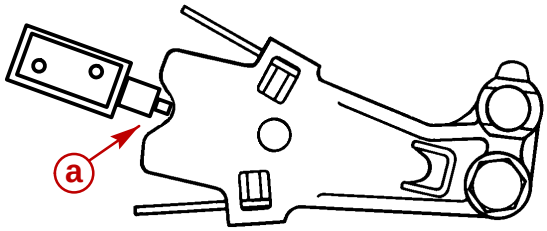
50309

a - Adjustable Stud



22058

a - Shift Cutout Switch Roller



75128

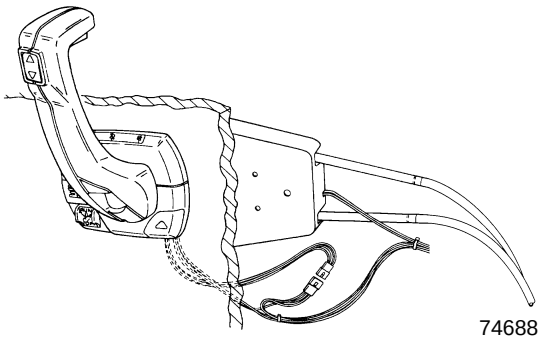
a - Shift Cutout Switch Plunger

Troubleshooting Shift Problems

NOTE: *The following information is provide to assist an installer in troubleshooting if hard shifting or chucking/racheting is encountered when shifting into FORWARD gear.*

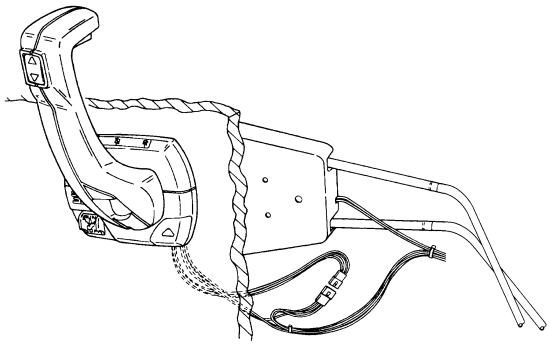
1. When installing the control box in the side panel of the boat, make sure that the cables have enough clearance to operate. This is necessary because the cables move up and down when the shift handle is moved. If the control box is mounted too far back towards any fiberglass structure, the cables will be interfered with, this will cause very hard shifting.

NOTE: *The control box housing can be rotated in 30° increments to improve cable routing.*



74688

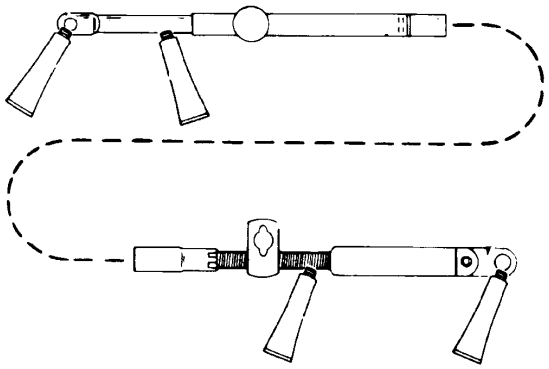
Proper Cable Bend



74689

Improper Cable Bend

2. Ensure that when the shift cable from the control box is led through the side gunnel of the hull, it does not have any extremely sharp bends in it as this will cause the stiff shifting.
3. Before installing the shift cable into the control box, extend the stainless rod eye end of the cable and grease it with 2-4-C Marine Lubricant with Teflon. Move it back and forth to allow even distribution of the grease.

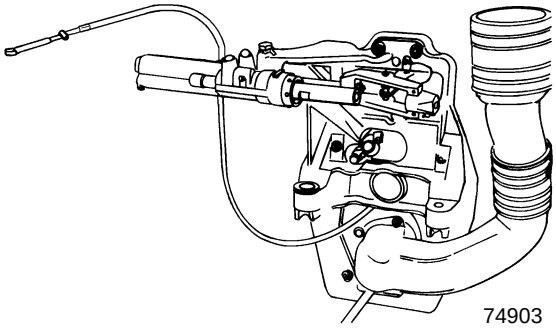


22005

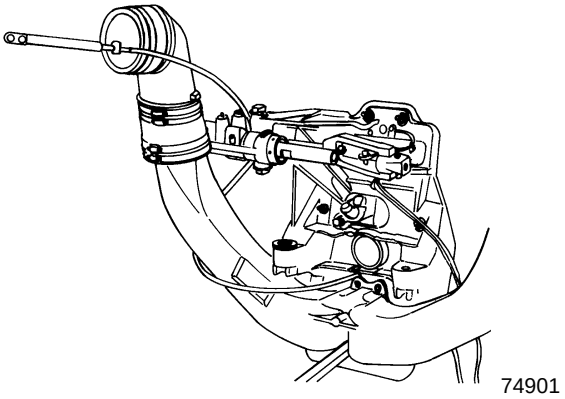
4. Do not strap or clamp the control cables to any other cables or rigid structure within **3 ft. (914 mm)** of the control box.
5. Be sure the cable is not permanently kinked.
6. Make sure there is proper clearance for cable movement when the control box is installed in the side panel. The cables must have room to move up and down when the control handle is shifted into either FORWARD or REVERSE.
7. Ensure that the engine was not set down on the intermediate shift cable during installation, as this will crush the inner cable tubing and cause improper and / or stiff shifting.

8. DO NOT fasten the shift cable with straps or clamps to any other cable within **5 ft. (1524 mm)** of the shift plate.
9. DO NOT fasten the shift cable to the transom with any type of plastic clips or fasteners within **5 ft. (1524 mm)** of the shift plate.
10. DO NOT overtighten the throttle or shift cable attaching nuts at the engine end. Barrel and cable end must be free to rotate on the mounting stud.
11. Check the intermediate shift cable routing from the transom assembly to the shift plate as follows:
    a. The cable should come through the transom, above the exhaust pipe and make a turn towards the starboard side of the boat between the exhaust pipe and the engine flywheel housing.
    b. The cable should then be routed under the starboard rear engine mount, and turn towards the transom.
    c. Then go up behind the power steering valve and loop over to the shift plate on the engine, where it is connected to the anchor points on the shift plate.

Following this routing will prevent the engine coupler from damaging the cable.



4 Cylinder Inline Model



V6 and V8 Models

Propeller Installation

⚠ WARNING

Be sure that remote control is in the neutral position and ignition key is removed from switch.

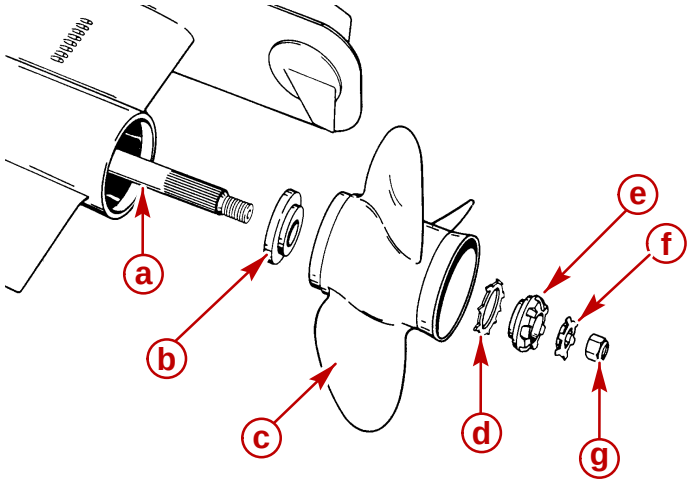
⚠ WARNING

Place a block of wood between the antiventilation plate to protect hands from propeller blades and to prevent propeller from turning.

1. To aid in future propeller removal, liberally coat the propeller shaft splines with one of the following lubricants; then, install propeller.

- Special Lubricant 101
- 2-4-C Marine Lubricant with Teflon
- Perfect Seal

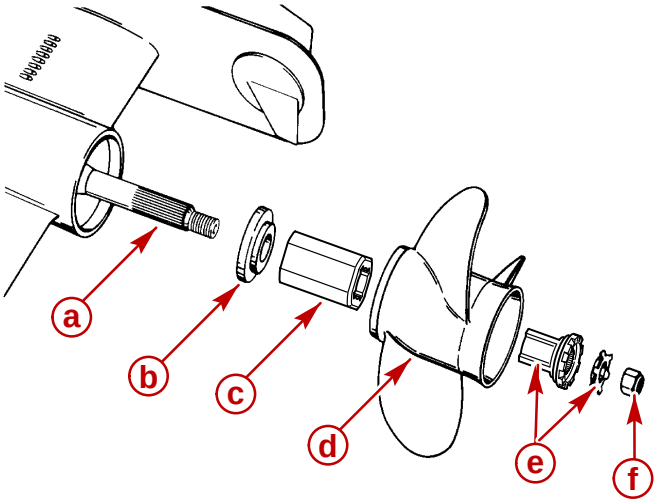
IMPORTANT: Installation is correct when at least 2 threads of propeller shaft are exposed through propeller nut.



22074

Propeller Without Flo-Torq II Drive Hub

- **a** - Propeller Shaft
- **b** - Forward Thrust Hub
- **c** - Propeller
- **d** - Continuity Washer
- **e** - Spline Washer
- **f** - Tab Washer
- **g** - Propeller Nut



70134

Propeller With Flo-Torq II Drive Hub

- **a** - Propeller Shaft
- **b** - Forward Thrust Hub
- **c** - Flo Torq II Drive Hub
- **d** - Propeller
- **e** - Drive Sleeve Adapter and Locking Tab Washer
- **f** - Propeller Nut

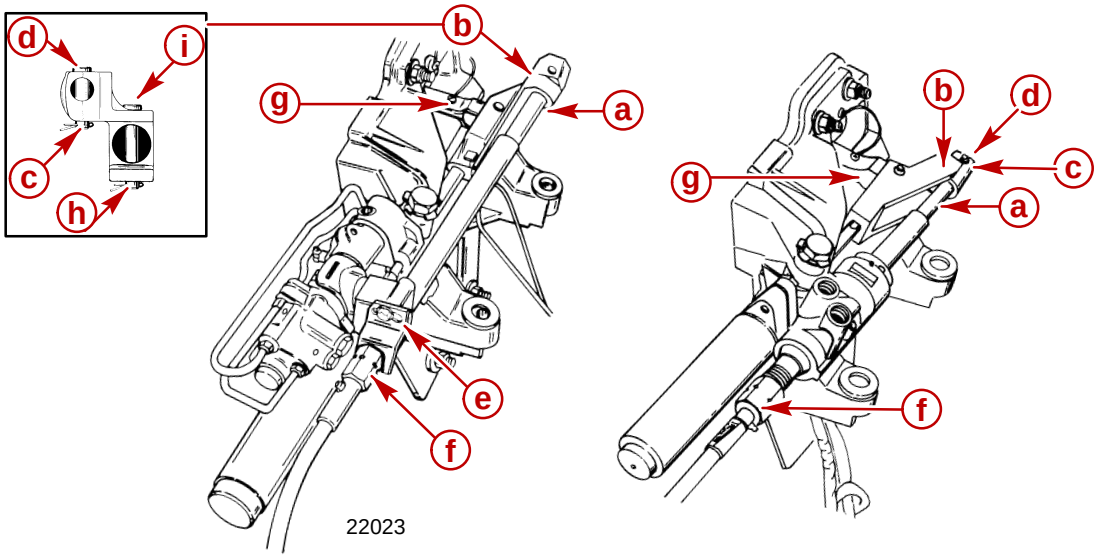
2. Torque propeller nut until 55 lb-ft (75 N•m) is obtained and continue until 3 tabs on tab washer align with grooves on drive sleeve.
3. Bend tabs into drive sleeve.

Transom Assembly Removal

Power Steering Models

NOTE: *If Tie Bars need to be removed or serviced see section 6A or 6B.*

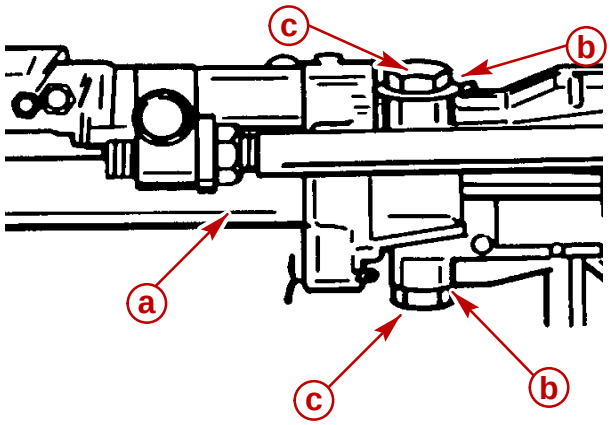
1. Remove the power steering assembly..
   a. Disconnect clevis from steering lever.
   b. Disconnect steering cable from clevis.



Earlier Model Control Valve . . . . . Later Model Control Valve

a - Cable End
b - Clevis
c - Cotter Pin
d - Clevis Pin
e - Locking Plate
f - Cable Retaining Nut
g - Steering Lever
h - Cotter Pin
i - Clevis Pin

c. Bend tabs away from pivot bolts then loosen bolts and remove power steering unit.

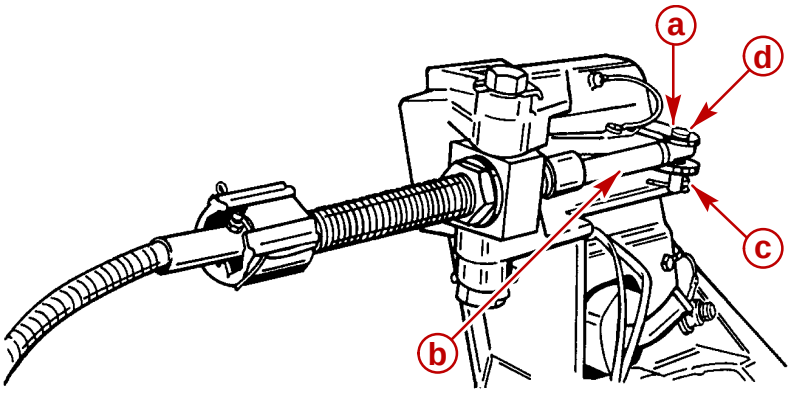


23256

a - Power Steering Unit
b - Tab Washer
c - Pivot Bolt

Manual Steering Models

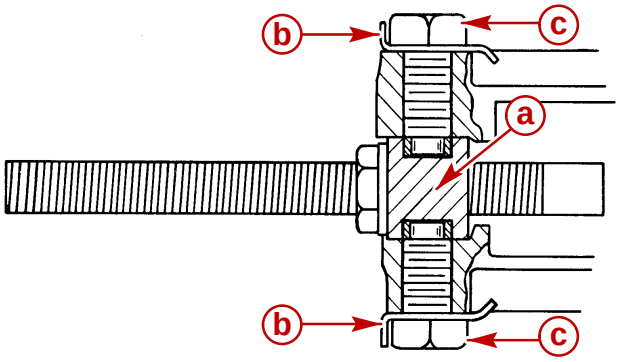
1. Remoe the manual steering assembly.
   a. Disconnect steering cable or clevis from steering lever.



22055

a - Steering Lever
b - Steering Cable
c - Cotter Pin
d - Clevis Pin

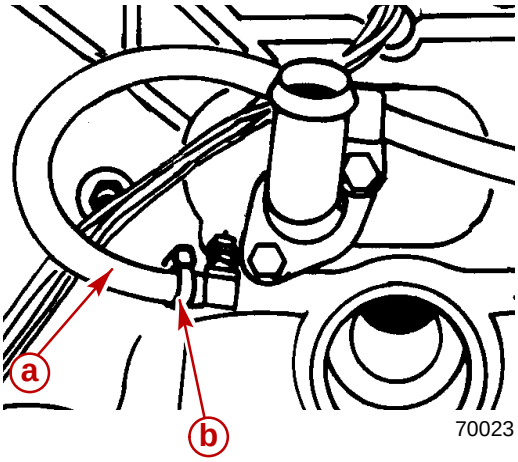
b. Bend tabs away from pivot bolts. Loosen bolts and remove manual steering swivel ring.



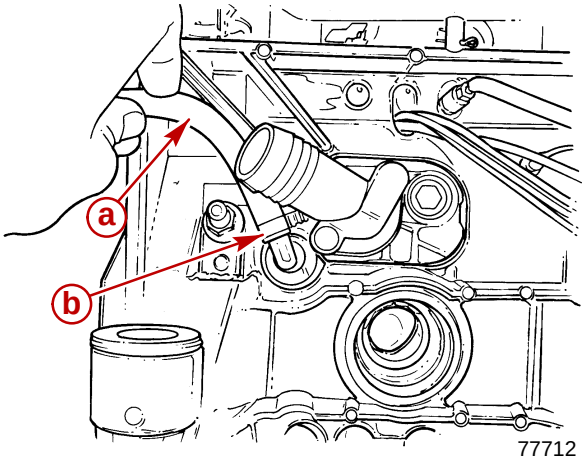
22945

a - Swivel Ring
b - Tab Washer
c - Pivot Bolt

2. Disconnect gear lube monitor hose, if equipped. Plug hose and cap fitting.



70023

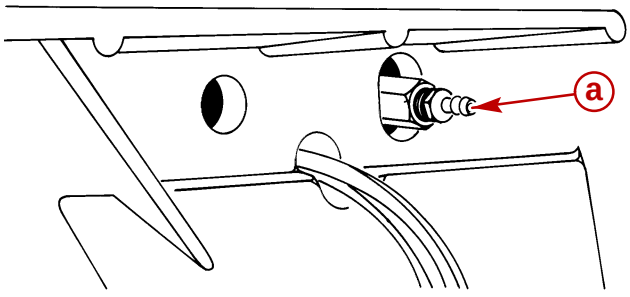


77712

..... Earlier Style ..... Later Style

a - Hose
b - Hose Clamp

3. Disconnect speedometer hose, if equipped.

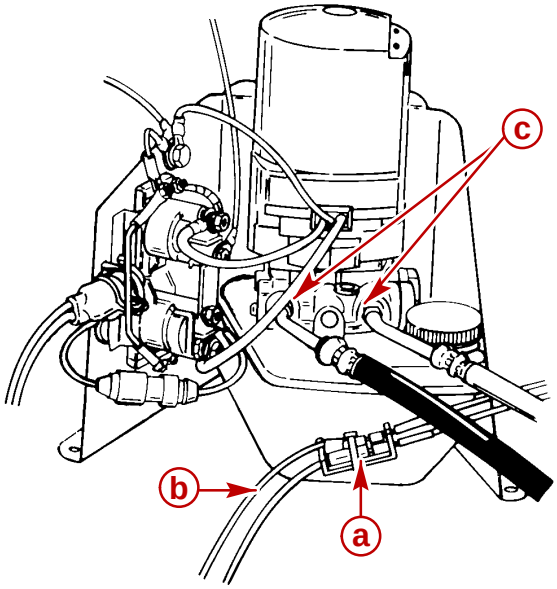


70015

a - Speedometer Fitting

4. Disconnect MerCathode wires from control unit on engine, if equipped.

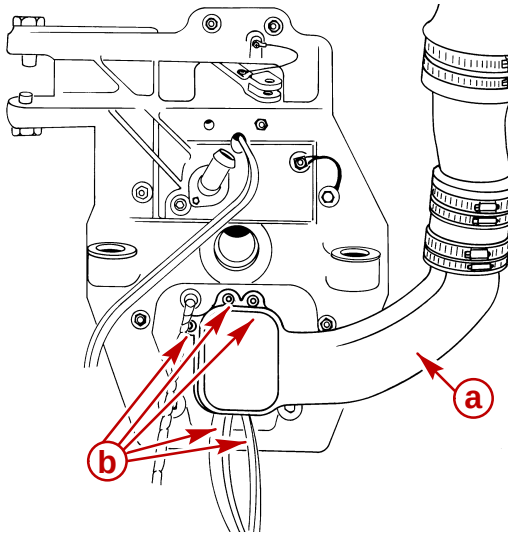
5. Disconnect trim limit switch wires at trim pump and trim position sender wires at engine.
6. For engine removal, refer to appropriate engine service manual.
7. Disconnect power trim hydraulic hoses from trim pump. Cap hoses and plug pump fitting holes.



22031

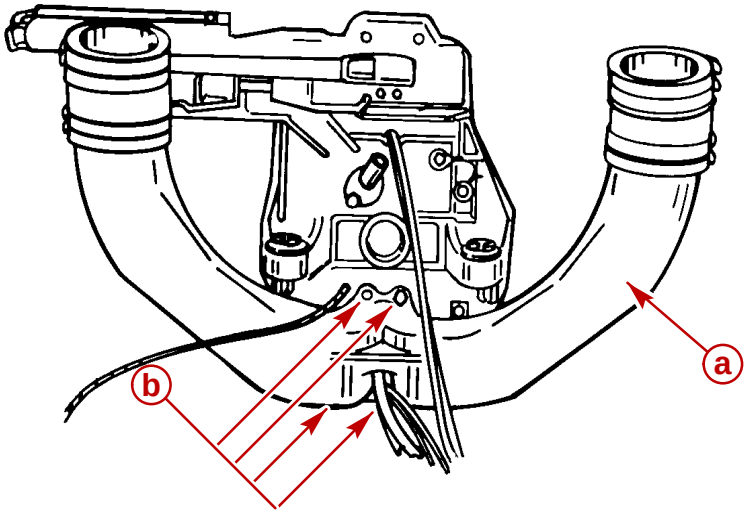
a - Sta-Strap
b - Trim Limit Switch Wires
c - Hydraulic Hoses

8. If installed, remove exhaust pipe.



70068

In-line 4 Cylinder Models

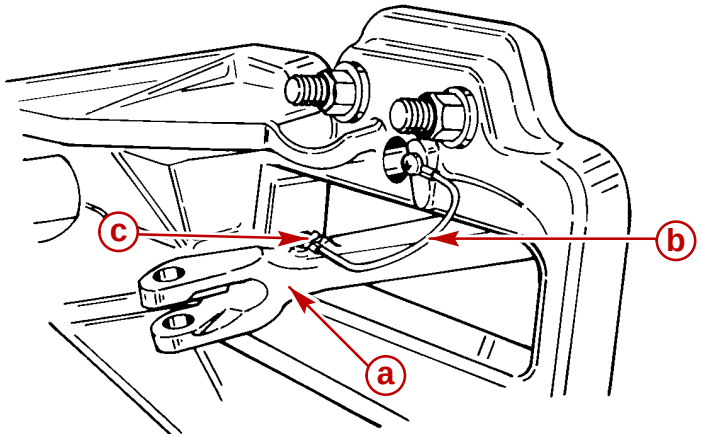


22057

V6/V8 Models

a - Exhaust Pipe
b - Screws

9. Remove ground wire from steering lever.



22028

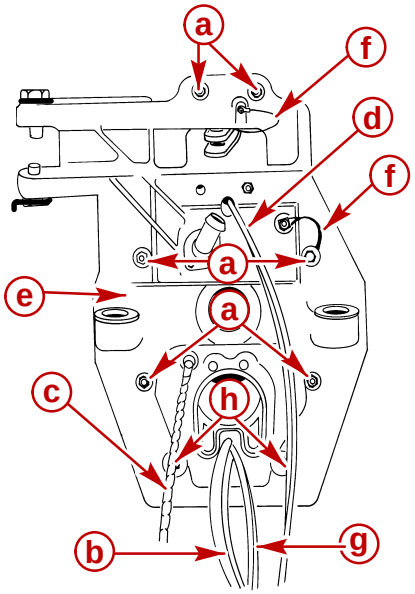
a - Steering Lever
b - Ground Wire
c - Screws

⚠ CAUTION

Transom gimbal housing (on outside of boat must be secured prior to the next step to prevent dropping.

10. Remove all nuts, bolts and washers (items “a” and “h” in diagram) and separate inner transom plate from transom gimbal housing.

11. Remove transom gimbal housing from transom of boat.



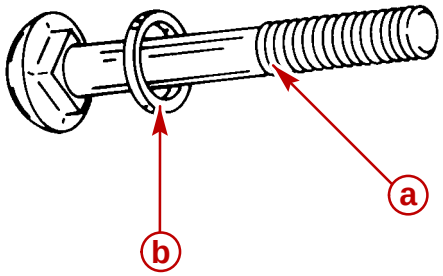
70012

a - Flat Washers and Locknuts
b - Hydraulic Hoses
c - Drive Unit Shift Cable
d - Trim Limit And Trim Position Sender Wires
e - Inner Transom Plate
f - Ground Wire (Continuity Circuit)
g - MerCathode Wires (If Equipped)
h - Long Screws, Lock Washers And Square Flat Washers (Later Models - Studs With Locknuts And Flat Washers)

Transom Assembly Installation

⚠ CAUTION

On earlier style transom assembly with carriage bolts at the bottom, rubber seal MUST BE installed on the bolts or water will leak into boat.

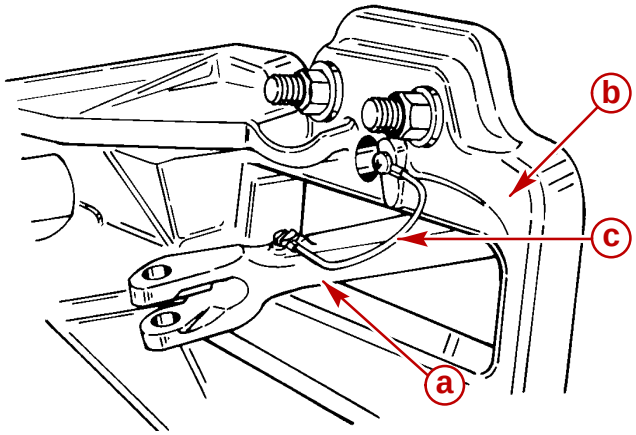


22028

a - Carriage Bolt
b - Rubber Seal

⚠ CAUTION

Steering lever ground wire MUST BE positioned as shown or wire may fatigue.



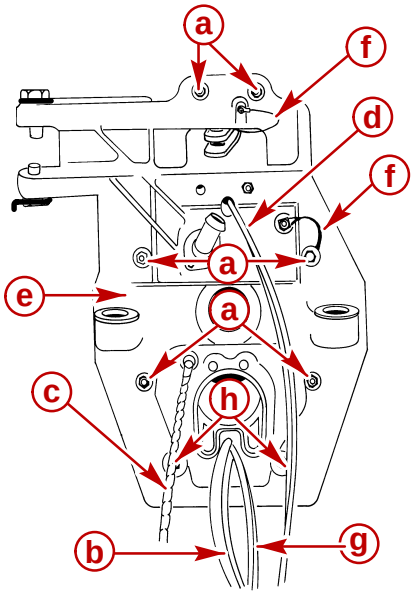
22028

a - Steering Lever
b - Inner Transom Plate
c - Ground Wire

IMPORTANT: Be sure to pull all wires and cables completely through inner transom plate and ensure wires are not pinched when installing gimbal housing to transom.

IMPORTANT: Torque bolts and nuts evenly (starting from center and working out) to 22.5 lb-ft (30.5 N•m).

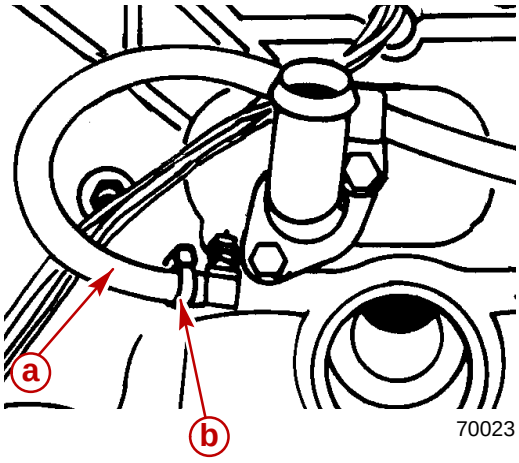
1. Install transom assembly. Tighten attaching bolts and nuts evenly (starting from center and working out). Torque to 22.5 lb-ft (30.5 N•m).



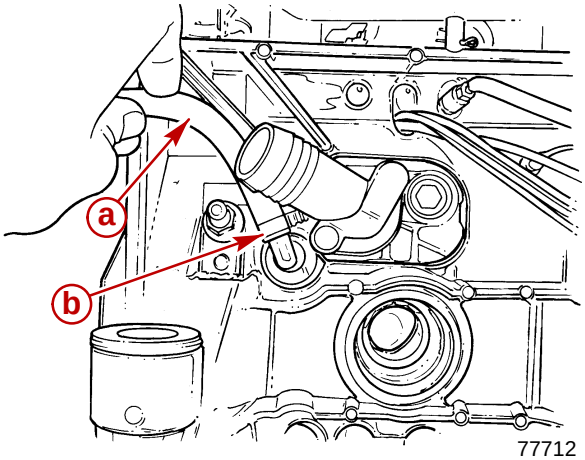
70012

a - Flat Washers and Locknuts
b - Hydraulic Hoses
c - Drive Unit Shift Cable
d - Trim Limit And Trim Position Sender Wires
e - Inner Transom Plate
f - Ground Wire (Continuity Circuit)
g - MerCathode Wires (If Equipped)
h - Carriage Bolts With Flat Washers And Locknuts (Later Models - Studs, Flat Washers And Locknuts)

2. If equipped, connect gear lube monitor hose.



70023

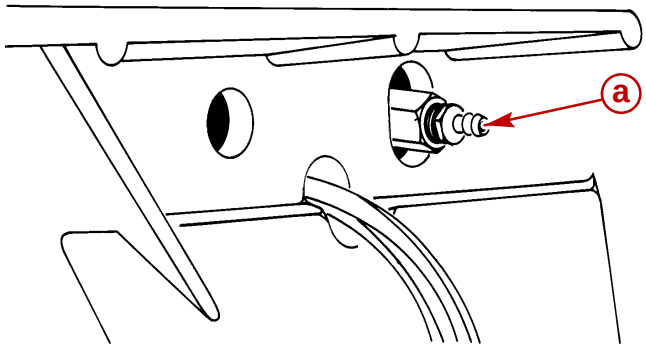


77712

. . . . . Earlier Style . . . . . Later Style

a - Hose
b - Hose Clamp

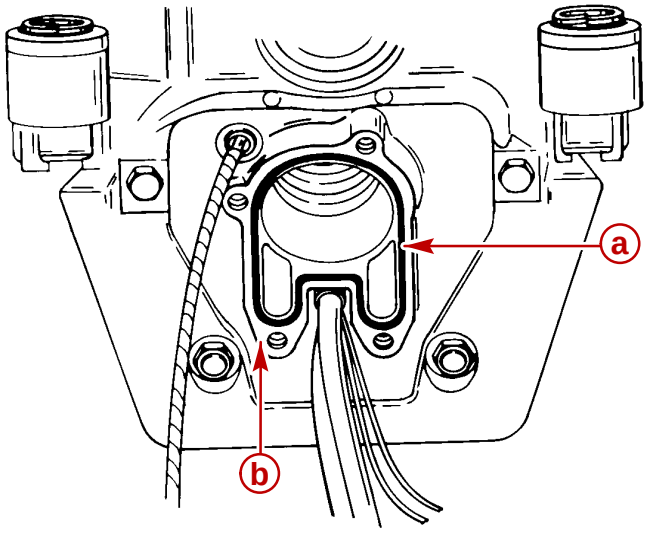
3. If equipped, connect hose from the speedometer to the barb fitting and secure with cable tie.



70015

a - Barb Fitting

IMPORTANT: Exhaust pipe and gimbal housing mating surfaces must be clean and free of nicks and scratches or exhaust may leak into boat.

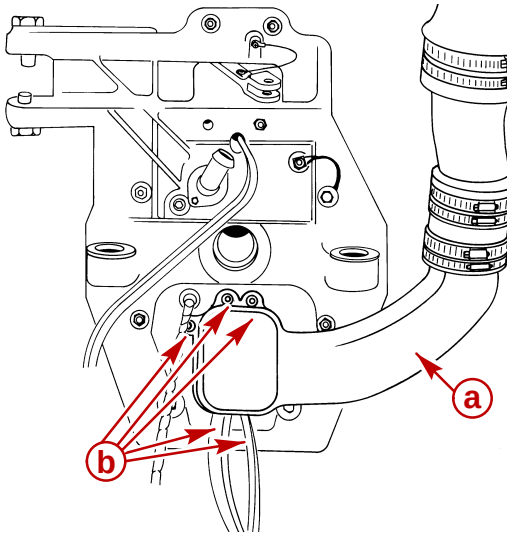


22057

a - O-ring Seal
b - Mating Surface

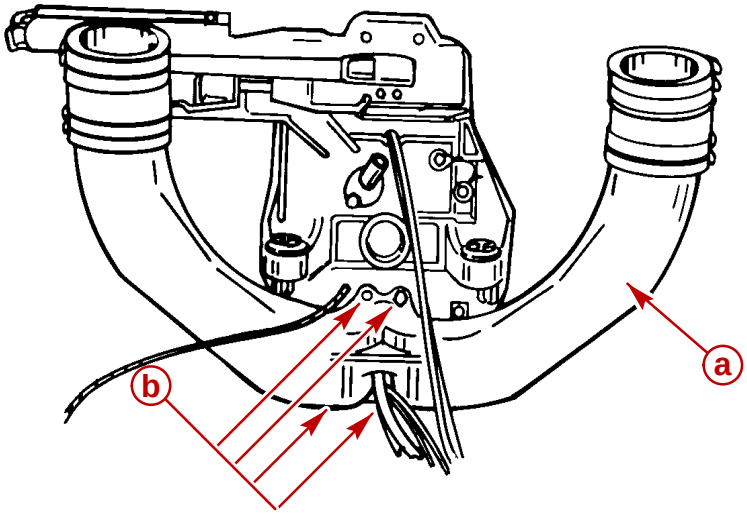
4. If equipped, glue O-ring seal to gimbal housing.

5. Install exhaust pipe or block off plate on gimbal housing. Torque screws to 22.5 lb-ft (30.5 Nm).



70068

In-line 4 Cylinder Models

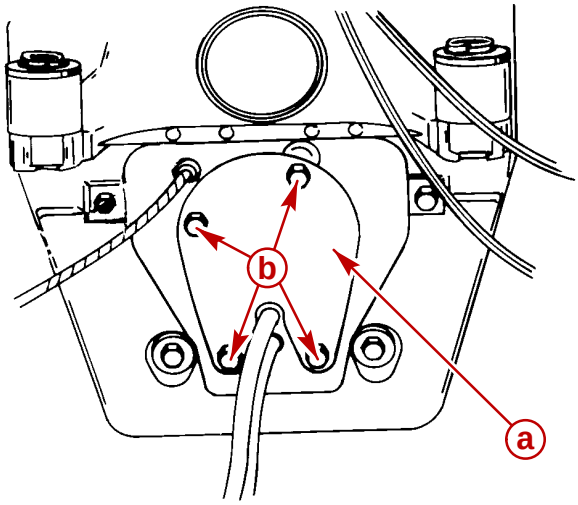


22057

V6/V8 Models

a - Exhaust Pipe
b - Screws

6. If using through-transom exhaust, install block off plate and O-ring seal. Torque to 22.5 lb-ft (30.5 Nm)



22057

Models with Through The Transom Exhaust

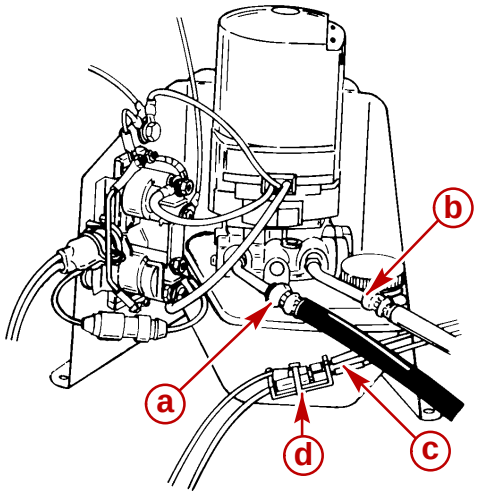
a - Block Off Plate
b - Screws

⚠ CAUTION

DO NOT cross thread or overtighten hose fittings when making hydraulic hose connections to power trim pumps.

IMPORTANT: Make hydraulic hose connections as quickly as possible to prevent oil from leaking out of trim system.

7. Connect power trim pump hydraulic hoses. Torque to 125 lb-in. (14.1 Nm).



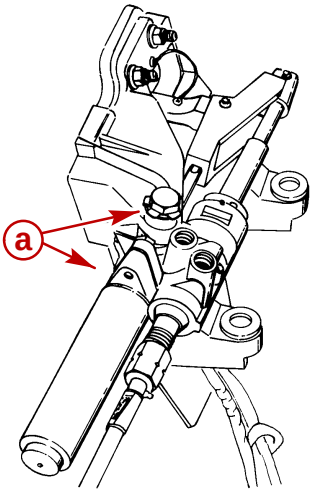
22031

a - Black Hose (Up Hose)
b - Gray Hose (Down Hose)
c - Trim Limit Switch Wires
d - Wire Retainer and Sta-Strap

8. Connect trim limit switch wires.

Power Steering Models

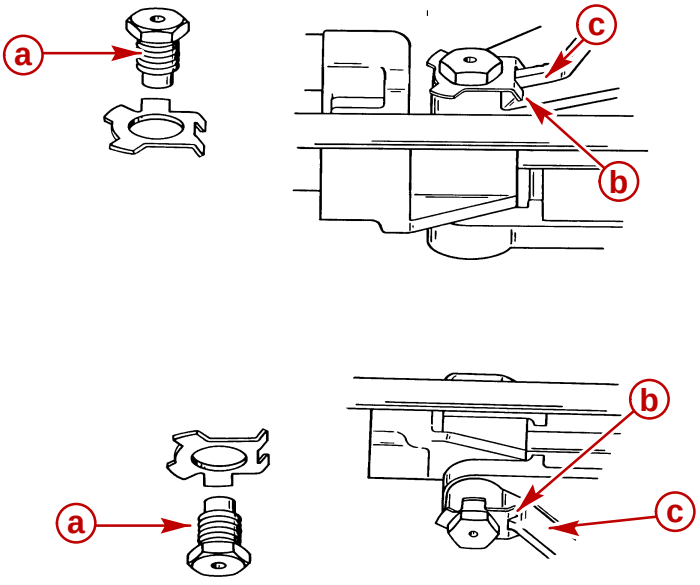
1. Install power steering assembly on inner transom plate.
   a. Lubricate power steering unit bushings with Special Lubricant 101.



71901

a - Power Steering Unit Bushings

   b. Slide power steering unit bushings between transom plate mounting brackets. Install two pivot bolts and at the same time, slightly move (wiggle) steering unit to ensure proper pivot bolt engagement into bushings. Ensure washer tangs straddle ridges on inner transom plate.



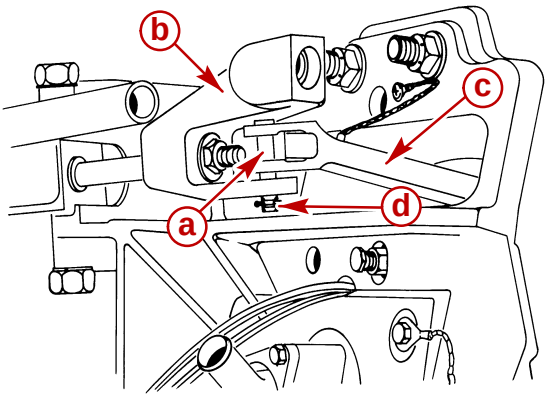
22168

a - Pivot Bolts
b - Washer Tangs
c - Ridges

   c. Torque pivot bolts to 25 lb-ft (34 Nm). Bend washer tabs against flat on bolt heads.

2. If equipped, connect power steering unit clevis to steering lever as follows:
   a. Lubricate clevis pin with Special Lubricant 101.
   b. Install clevis pin through clevis and steering lever from top.

c. Secure clevis pin with cotter pin. Bend both ends of cotter pin.



70019

a - Clevis Pin
b - Clevis
c - Steering Lever
d - Cotter Pin

⚠ WARNING

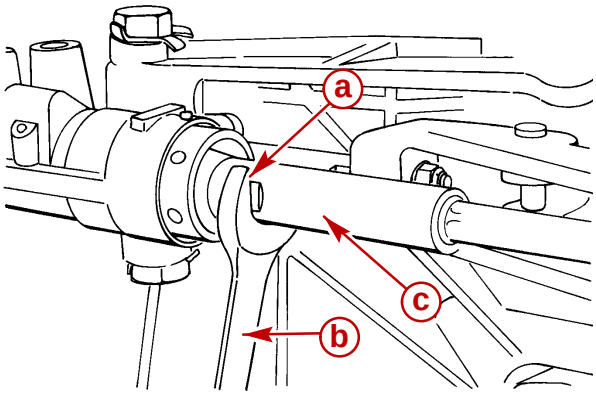
Failure to use a steering cable locking device could cause a loss of steering, which could cause damage to the boat and/or injury.

All current production Quicksilver Ride Guide steering cables have a self-locking coupler nut and do not require an external locking device. (Other cable manufacturers also make cables with a self-locking coupler nut.)

3. Install steering cable.

   a. Lubricate steering cable end with a liberal amount of Special Lubricant 101 and install cable end through guide tube.

   b. **Later Model Control Valve:** Using a suitable wrench, hold the flat surfaces on the cable guide tube in the vertical position.



73901

Later Model Control Valve

a - Flat (Hold Vertical)
b - Suitable Wrench
c - Guide Tube

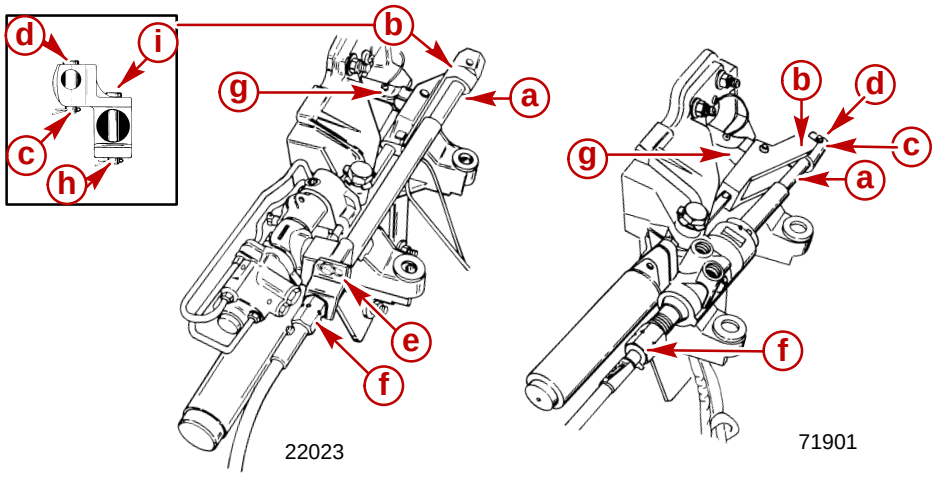
   c. **Both Models:** Connect cable end to clevis with clevis pin. Secure clevis pin in clevis with cotter pin. Bend both ends of cotter pin.

d. Tighten cable coupler nut. Torque to 35 lb-ft (48 Nm).

NOTE: *On later models, manually hold the guide tube while tightening the coupler nut.*

e. **Earlier Model Control Valve:** If required, install locking plate on coupler nut and secure with screw and washer. Torque to 66 lb-in. (7.5 Nm).

NOTE: *Later model control valves DO NOT have a locking plate.*



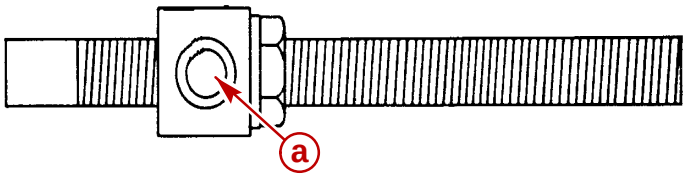
Earlier Model Control Valve . . . . . Later Model Control Valve

- **a** - Cable End
- **b** - Clevis
- **c** - Cotter Pin
- **d** - Clevis Pin
- **e** - Locking Plate
- **f** - Cable Retaining Nut
- **g** - Steering Lever
- **h** - Cotter Pin
- **i** - Clevis Pin

Manual Steering Models

1. Install manual steering assembly on inner transom plate.

   a. Lubricate swivel ring bushings with Special Lubricant 101.

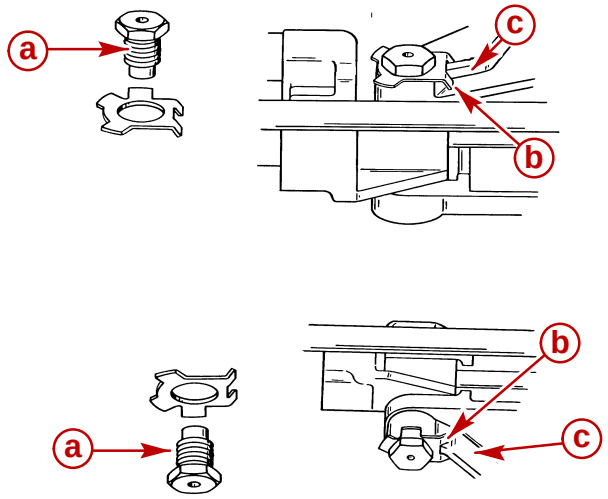


22946

a - Swivel Ring Bushings

   b. Slide manual steering swivel ring and bushings between transom plate mounting brackets. Install two pivot bolts and at the same time, slightly move (wiggle) swivel

ring to ensure proper pivot bolt engagement into swivel ring bushings. Ensure washer tangs straddle ridges on inner transom plate.



22168

a - Pivot Bolts
b - Washer Tangs
c - Ridges

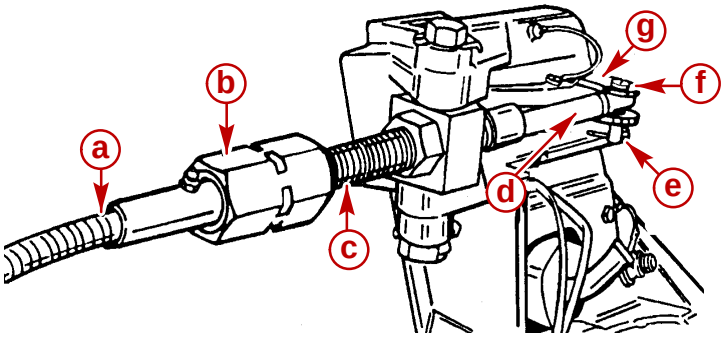
c. Torque pivot bolts to 25 lb-ft (34 Nm). Bend washer tabs against flat on bolt heads.

2. Install steering cable.

a. Lubricate steering cable end with a liberal amount of Special Lubricant 101 and install cable end through guide tube.

b. Connect steering cable to steering lever and secure with clevis pin and cotter pin. Spread both ends of cotter pin.

c. Tighten coupler nut. Torque to 35 lb-ft (48 Nm).



70373

a - Steering Cable
b - Cable Coupler Nut
c - Steering Cable Guide Tube
d - Steering Cable End
e - Cotter Pin
f - Clevis Pin
g - Steering Lever

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STERNDRIVE UNIT

Section 3A - Drive Shaft Housing

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3 A

Specifications

Torque Specifications

Description	Torque		
	lb-in.	lb-ft	Nm
Top Cover Screws		20	27
U-joint Retainer Nut*		200	271
Nuts, Bolts And Washers		35	47.5
Nut		35	47.5
Screw		28	41
Trim Tab Screw		23	31
Dipstick	17.5		2
Oil Vent Screw	40		4

*See Torque Wrench Chart.

Upper Drive Shaft Bearing Preload

Description	Torque	
	lb-in.	Nm
New Bearings	8	0.9
Used Bearings*	5	0.6

*Bearings are considered used if spun under load once.

U-joint Bearing Preload

Description	Torque	
	lb-in.	Nm
New Bearings	6-10	0.7-1.1
Used Bearings*	3-7.5	0.3-0.8

*Bearings are considered used if spun under load once.

Gear Shimming Specifications

Description	Gear Location	
	inches	millimeters
Drive Gear	.025	0.64
Driven Gear	.025	0.64

Lubricants/Sealers/Adhesives

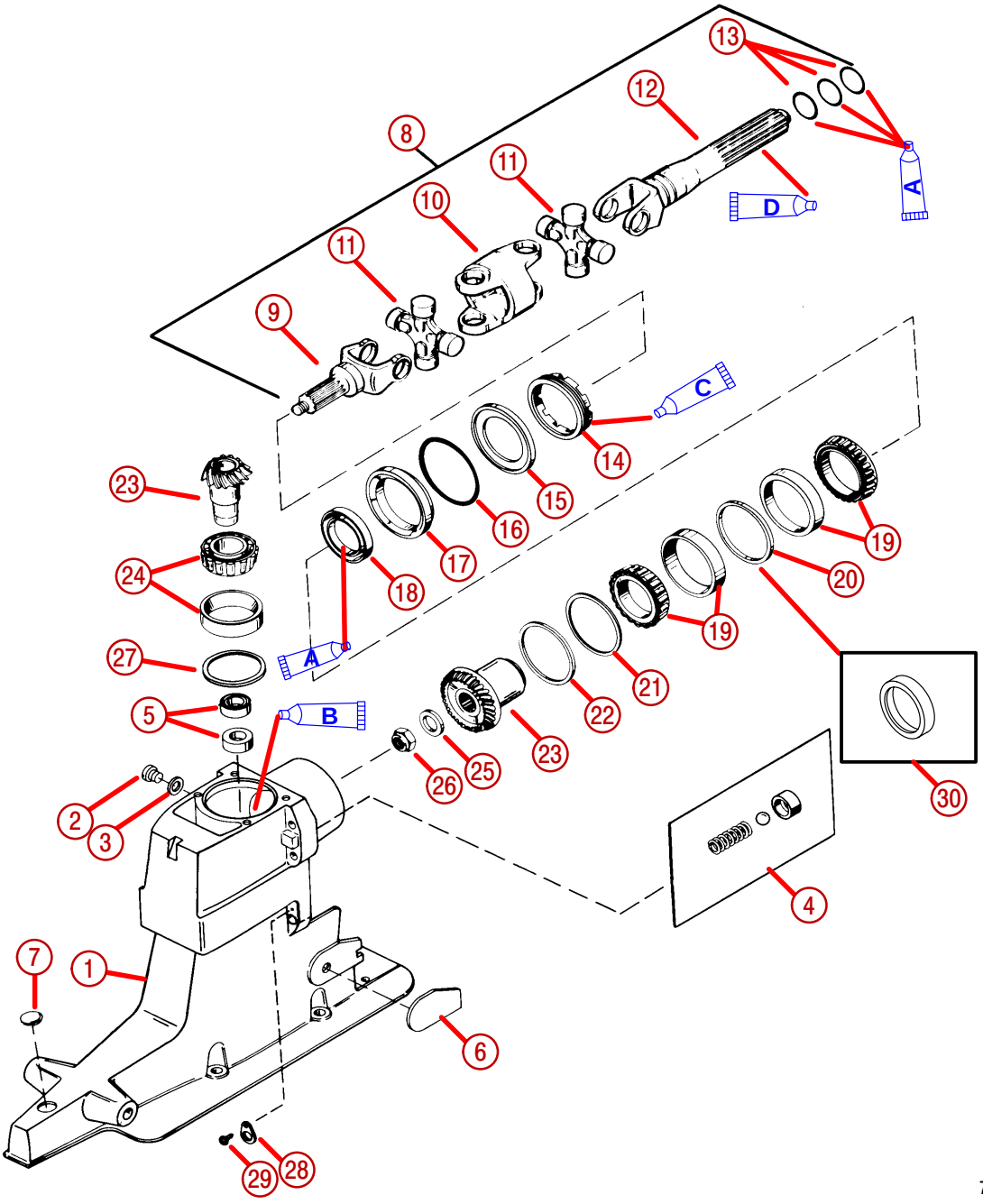
Description	Part Number
Quicksilver 2-4-C Marine LubricantWith Teflon	92-825407A12
Quicksilver U-jointAnd Gimbal Bearing-Grease	92-828052A2
3M Brand Adhesive	92-86166-1
Quicksilver Needle Bearing Assembly Lubricant	92-825265A1
Quicksilver Perfect Seal	92-34227-1
Permatex Ultra Blue Silicone Sealant	Obtain Locally
Quicksilver Special Lubricant 101	92-13872A1
Quicksilver High Performance Gear Lube	92-816026A4

Special Tools

Description	Part Number
U-joint Adaptor	91-38756
Bearing Cup Driver	91-38918
Bearing Cup Driver	91-808053
Bearing Cup Driver	91-33493
Bearing Cup Driver	91-36577
Driver Rod	91-37323
Driver Tool	91-90774
Oil Seal Driver	91-817570
Shimming Tool (Driven Gear)	91-60526
Shimming Tool (Driven Gear)	91-854377
Shimming Tool (Drive Gear)	91-60523
Slide Hammer Puller	91-34569A1
Torque Wrench (lb-in.)	91-66274
U-joint Bearing Retainer Wrench	91-17256
Universal Puller Plate	91-37241

Drive Shaft Housing Exploded Parts View

U-joint and Driven Gear Components



1 - Drive Shaft Housing	**16** - O-ring
2 - Screw	**17** - Carrier Assembly
3 - O-ring Or Washer	**18** - Oil Seal
4 - Spring Assembly	**19** - Roller Bearing And Cups
5 - Oil Seal	**20** - Spacer Cup (S/N Prior To 0L100009)
6 - Wear Pad	**21** - Shim
7 - Plug	**22** - Shim
8 - Universal Joint	**23** - Drive Gear Assembly
9 - Yoke, Universal Joint-gear End	**24** - Roller Bearing And Cup
10 - Socket, Center-universal Joint	**25** - Washer
11 - Cross And Bearing	**26** - Nut
12 - Yoke Assembly, Universal Joint-coupling End	**27** - Shims
	28 - Ground Plate
13 - O-ring	**29** - Screw
14 - Retainer	**30** - Spacer Cup (S/N 0L100009 And Above)
15 - Ring	

Lubricants/Sealers/Adhesives

NOTE: *Fill Drive With High Performance Gear Lube*

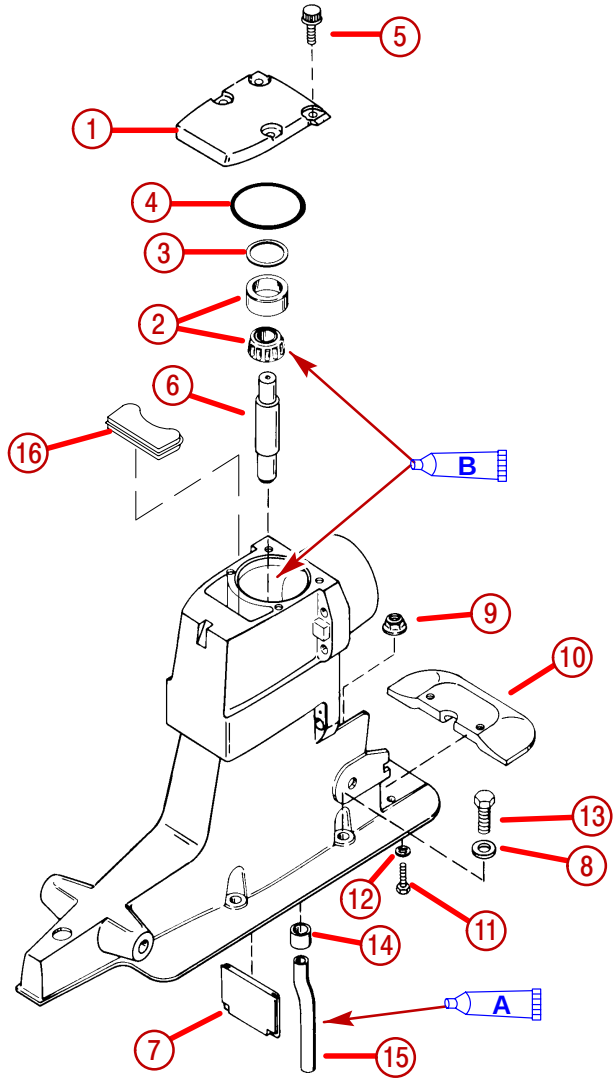
- 2-4-C Marine Lubricant With Teflon

- Quicksilver High Performance Gear Lube

- Special Lubricant 101

- Quicksilver Engine Coupler Spline Grease

Drive Shaft Components



1 - Cover, top	**9** - Nut
2 - Bearing and Cup	**10** - Anodic Plate
3 - Shim	**11** - Screw
4 - O-ring	**12** - Lockwasher
5 - Screw	**13** - Screw
6 - Drive Shaft, upper	**14** - Seal
7 - Filler Wall	**15** - Water Tube
8 - Washer	**16** - Stuffer Plug

Lubricants/Sealers/Adhesives

A - 2-4-C Marine Lubricant With Teflon

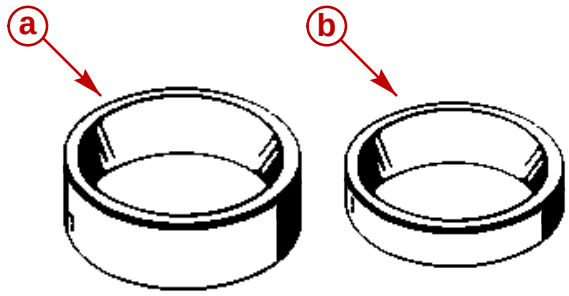
B - Quicksilver High Performance Gear Lube

NOTE: *Fill Drive with High Performance Gear Lube*

Special Information

Top Cover Bearing Cup

The later style bearing cup is thinner than the earlier style cup.



75240

a - Earlier Style Bearing Cup 1.938 in. (49 mm) Diameter (Prior to S/N OF680000)
b - Later Style Bearing Cup 1.781 in. (45 mm) Diameter (S/N OF680000 And Above)

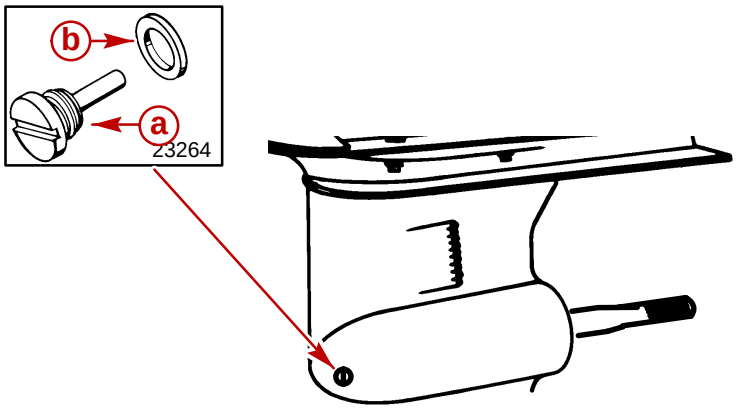
Universal Joint Bearing Set

IMPORTANT: Alpha One Sterndrive Units beginning with serial number 0L100009 and above no longer use the cone spacer between the bearings in the U-joint assembly to set the bearing preload. A new procedure has been established for adjusting this preload and is covered in the following instructions. The O.D. of the new drive gear bearing carrier has changed to 3.265 in. (82.9 mm).

Drive Shaft Housing/Gear Housing

Separation

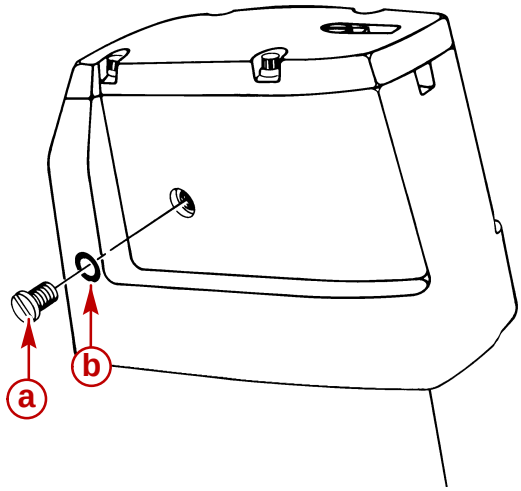
1. Clamp the unit on the gear case anti-ventilation plate in a suitable fixture.
2. Trim drive unit to full UP/OUT position.
3. Remove the oil fill/drain plug.



75703

a - Fill/Drain Screw
b - Sealing Washer

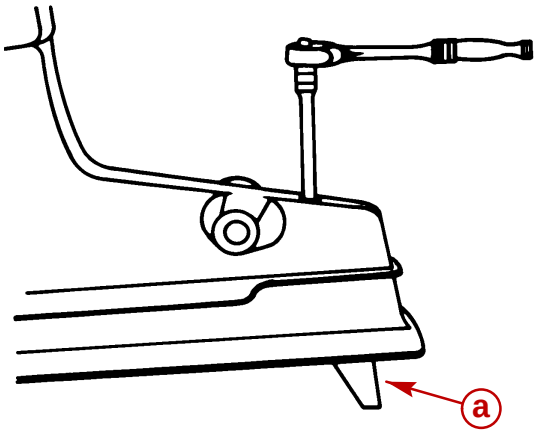
4. Remove the drive shaft housing vent screw. Allow the drive unit to drain completely.



70131

a - Vent Screw
b - Sealing Washer

5. If equipped, mark the trim tab position with a piece of tape on the gear housing and remove the trim tab.

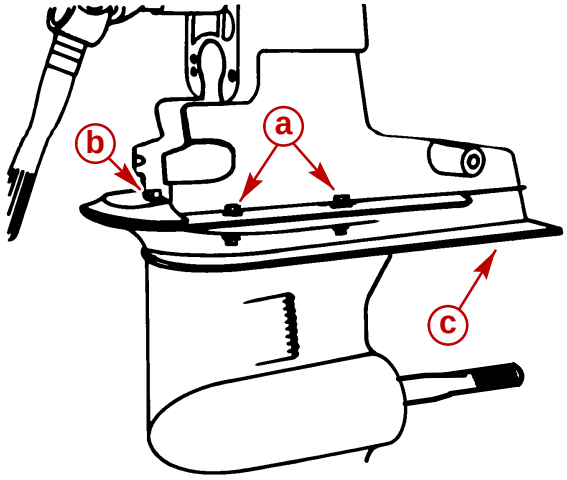


70116

a - Trim Tab

6. Remove the aft screw (in the trim tab well of the gear housing).
7. Remove the bolts, nuts and washers from the port and starboard sides of the unit.

8. Remove the nut from the forward end of the unit.



75703

a - Nuts, Bolts And Washers
b - Nut
c - Screw

9. Lift the drive shaft housing straight off of the gear case and set aside.

NOTE: *It may be necessary to lightly tap housing with a synthane hammer to assist removal.*

Drive Shaft Housing and Component Disassembly

Drive Unit Gear Ratio Identification

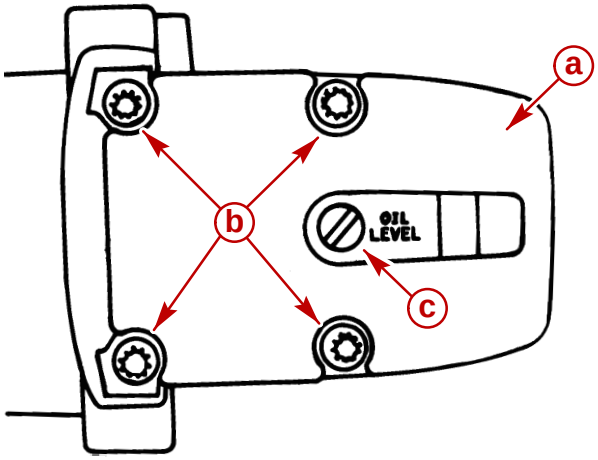
All drive unit gear ratios are identified on each drive in two places. It is important to note the ratio of the drive unit before preceding with any repairs. The first place to look is on the decal on the port side of the drive shaft housing. It will have a number such as (1.50R) and then the serial number. The second place to look will be on the universal joint splined yoke. It will be identified with a letter such as (F). This method is explained in the following chart.

ALPHA	
A	2.0:1
B	1.98:1
C	1.62:1, 1.65:1
D	1.81:1, 1.84:1
F	1.47:1, 1.50:1
H	1.32:1
K	2.40:1
M	1.50:1 MAGNUM

This will be true for new or with drive units that have not been altered. A drive unit could have had the gear ratio changed for high altitude, which would void any application of the above chart. The gear ratio then would have to be determined by counting the teeth on the drive gear and the driven gear in the drive shaft housing and using the following chart for reference.

Tooth Count	Ratio	Drive	Driven
14-28	2.40:1	20	24
14-28	2.0:1	24	24
17-28	1.98:1	20	24
17-28	1.81:1, 1.84:1	17	19
17-28	1.62:1, 1.65:1	24	24
17-28	1.47:1, 1.50:1	22	20
17-28	1.32:1	20	16

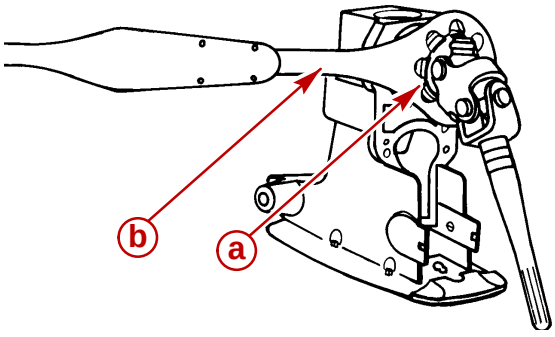
1. Remove the dipstick and washer, if present, in the top cover and remove the fasteners securing the top cover to the drive shaft housing. Lift the top cover straight off. It may be necessary to pry the top cover off by using a pair of screwdrivers (one on each side) in the slots provided at the junction of the top cover and the drive shaft housing.



70118

a - Top Cover
b - Screws
c - Dipstick (Early Models)

2. Remove the U-joint retainer.

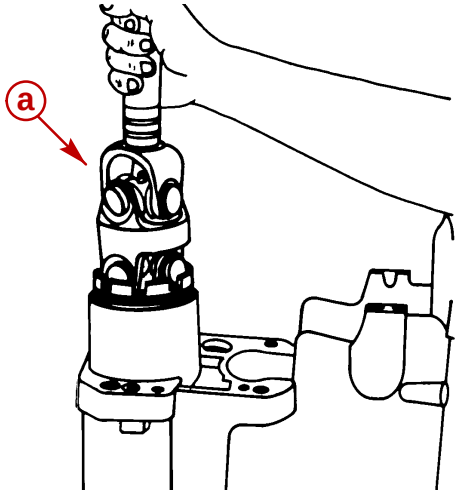


70209

a - U-joint Retainer
b - U-joint Retainer Tool

3. Remove the U-joint assembly by pulling it straight out.

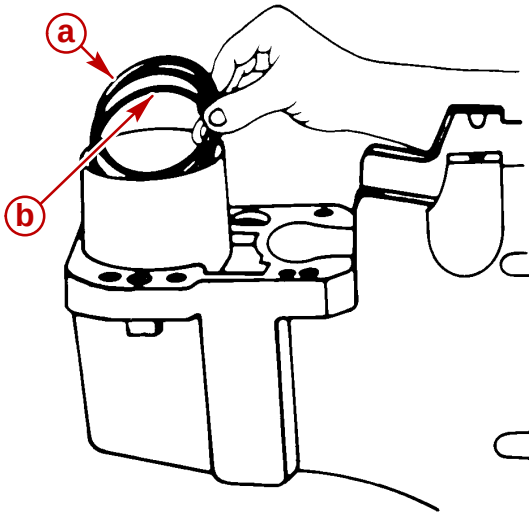
NOTE: *A synthane hammer may be used to tap on housing to assist removal.*



70122

a - U-joint Assembly

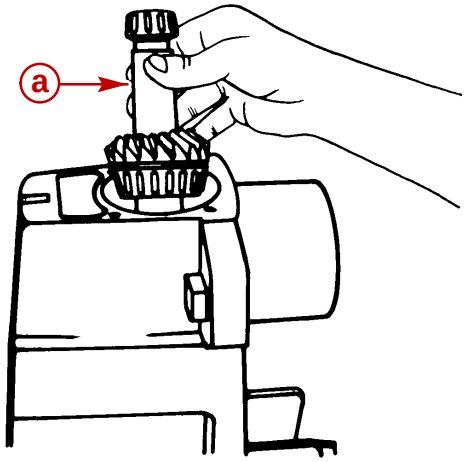
4. Remove the shim pack and the spacer ring. Measure and make note of the shim pack thickness. The shims may be reused if they are not damaged.



70123

a - Shims
b - Spacer Ring (On Some Models)

5. Remove the driven gear assembly by pulling it straight up and out of the drive shaft housing.

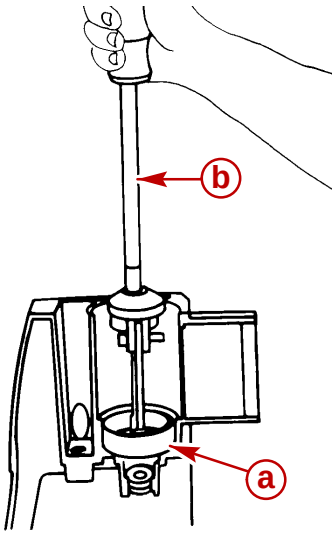


70124

a - Driven Gear Assembly

IMPORTANT: Removal of the driven gear bearing cup is only necessary for replacement of the cup or drive shaft housing, installing new oil seals and/or the changing of the shims below the cup for adjusting the driven gear location.

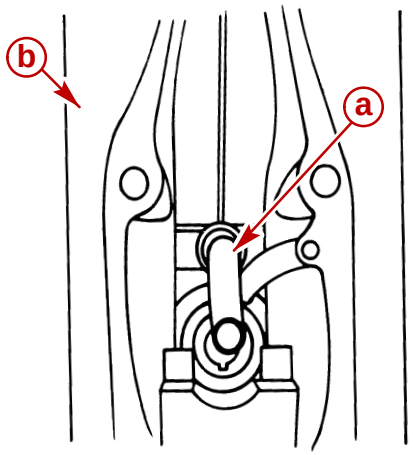
6. Remove the driven gear bearing cup and shim(s). Measure and make note of the shim pack thickness. Discard the shim(s) if they have been damaged.



70128

a - Bearing Cup
b - Slide Hammer Puller

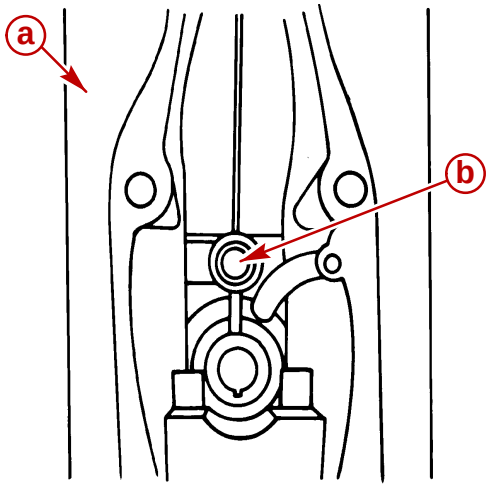
7. Remove the water tube from the drive shaft housing.



70126

a - Water Tube
b - Drive Shaft Housing

8. Remove the rubber seal from the drive shaft housing.



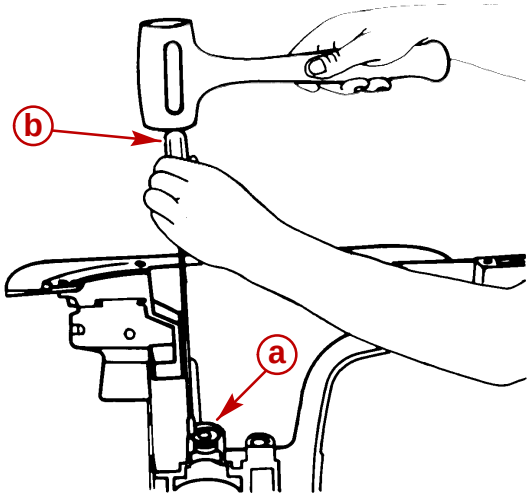
70125

a - Rubber Seal
b - Drive Shaft Housing

⚠ CAUTION

Eye protection must be worn when performing the following procedure. Failure to do so may cause personal injury.

9. Remove the drive shaft housing oil seals as shown in the figure below.



70129

a - Oil Seals (2)
b - Suitable Tool

Drive Shaft Housing Cleaning and Inspection

⚠ CAUTION

Eye protection must be worn when performing the following procedure. Failure to do so may cause personal injury.

1. Clean the drive shaft housing thoroughly with a suitable solvent and a hard bristle brush. Dry the drive shaft housing thoroughly using compressed air. Ensure that all sealants, locking agents and debris are removed.
2. Inspect the drive shaft housing for corrosion and any other damage. Excessive damage will require the replacement of the drive shaft housing.
3. Inspect the U-joint retainer threads in the drive shaft housing for corrosion, stripped and/or cross-threaded threads. Excessive damage to the threads will require the replacement of the drive shaft housing.
4. Inspect for blockage of the water and oil passages. Clean as necessary.

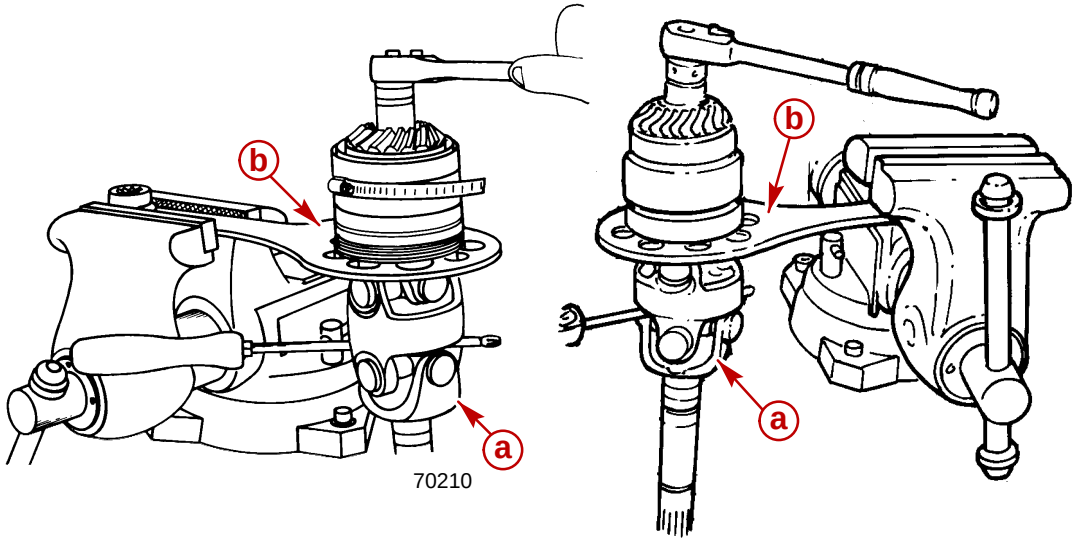
U-joint Assembly - Inspection and Disassembly

1. Remove and discard the two small O-rings on the spline end of the U-joint.
2. Clamp the U-joint retainer tool in a vise and insert the U-joint assembly into it from the top.

⚠ CAUTION

When accomplishing the following steps it is necessary to prevent the U-joint from falling when removing the lock nut. Failure to follow this instruction may cause personal injury and/or damage to the assembly.

3. While holding the U-joint, remove the locknut and washer from the U-joint shaft.



..... Earlier Model ..... Later Model

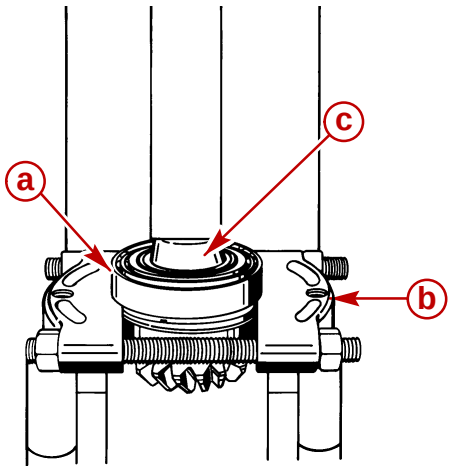
a - U-joint Assembly
b - U-joint Retainer Tool

⚠ CAUTION

Eye protection must be worn when performing the following procedure. Failure to do so may cause personal injury.

4. Remove gear and bearing assembly from shaft.
5. Remove bearings from gear and ensure that the bearing cones and cups remain together as a set utilizing a piece of wire to keep them together.

IMPORTANT: After disassembly inspect the bearing cones and cups for damage that may have occurred during removal from the gear. If either of the bearing cups or cones have been damaged, it will be necessary to replace both bearing cups and both bearing cones.

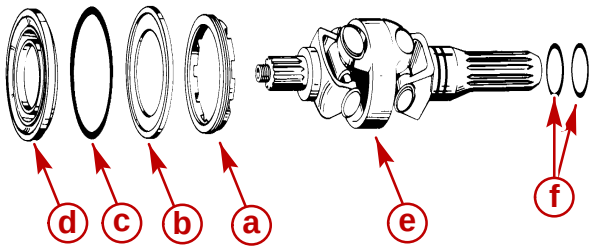


22393

a - Gear/Bearing Assembly
b - Universal Puller Plate
c - Suitable Mandrel

6. Clean all components with a suitable solvent and dry them thoroughly using compressed air.
7. Inspect the pinion gear bearings by rotating them by hand. Rough, uneven movement or a loose condition indicates the need for replacement of the bearings and cups.
8. Inspect the large O-ring around the oil seal carrier for damage or excessive compression. Replace the O-ring if it is found to be defective.
9. Inspect the gear for pitting, chipped or broken teeth, hairline fractures and excessive or uneven wear. Replace both the drive (pinion) gear and the driven gear if any of these conditions exist.
10. Inspect the U-joint retainer for damage, cracks and/or broken or corroded threads. Replace it if any of these conditions are found.

11. Inspect the thrust ring for cracks, damage and/or excessive wear. Replace it if any are found.



23010

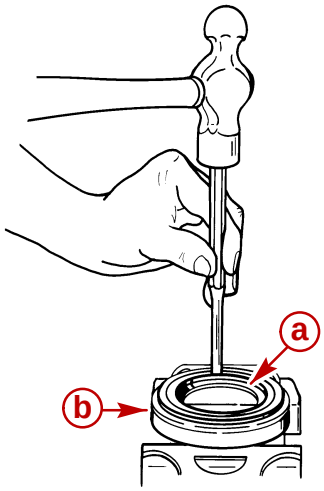
a - Retainer
b - Thrust Ring
c - O-ring, Large
d - Oil Seal Carrier
e - U-joint
f - O-rings

Oil Seal Carrier Subassembly

INSPECTION AND DISASSEMBLY

1. Inspect the oil seal carrier and oil seal for damage or excessive wear. If the carrier is found to be defective, replace the carrier and the oil seal as a unit. If only the oil seal is found to be defective, replace it as outlined.

   a. Remove the U-joint oil seal from the oil seal carrier using a punch and a hammer.

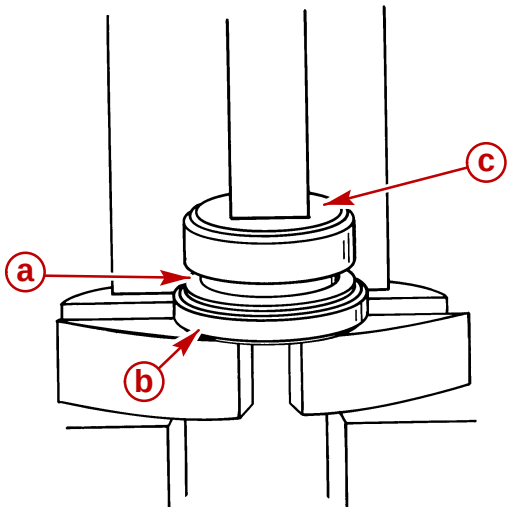


23009

a - Oil Seal
b - Oil Seal Carrier

OIL SEAL CARRIER - REASSEMBLY

1. Assemble the oil seal into the oil seal carrier by pressing it with the lip of the seal facing away from the stepped side of the carrier. Use the oil seal driver tool (91-36577) to press the seal into place.



23009

a - Oil Seal
b - Oil Seal Carrier
c - Oil Seal Driver Tool

Pinion Gear Subassembly

DISASSEMBLY

NOTE: *For removal of bearing pack from gear, refer to page 3A-16 .*

NOTE: *If by previous inspection both the pinion gear and the bearings have been found to be in good condition, skip this whole section.*

NOTE: *If by previous inspection both the pinion gear and the bearings have been found to be in need of replacement, order new parts, (pinion gear, pinion gear bearings and cups and driven gear), skip this disassembly section and go to "Reassembly."*

NOTE: *If by previous inspection the pinion gear has been found to be in need of replacement* ***both the pinion gear and the driven gear must be replaced as a set.***

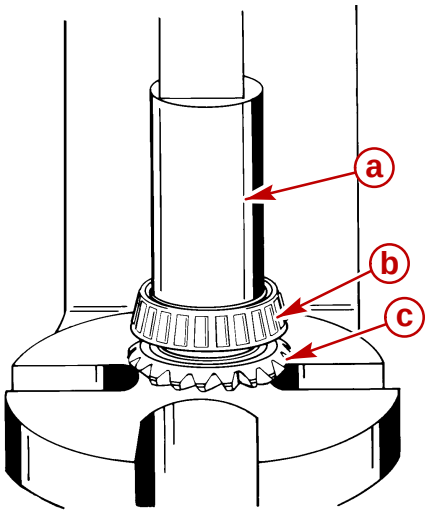
NOTE: *If by previous inspection the bearings have been found to be in need of replacement* ***both bearing cups and both bearing cones must be replaced as a set****.*

IMPORTANT: If the bearings are to be re-used (when replacing only the pinion and driven gears), make sure that the bearing cones and cups were kept together in their original pairing and are reassembled in the same order, (i.e. the bearing cone and cup that were closest to the old gears' teeth must be reinstalled closest to the new gears' teeth).

REASSEMBLY

IMPORTANT: Lightly lubricate the gears and bearings with Quicksilver High Performance Gear Lube before installing. Bearings and gears must be lubricated to obtain accurate preload readings.

1. Press the bearing cone onto the pinion gear until it seats fully against the back side of the gear.



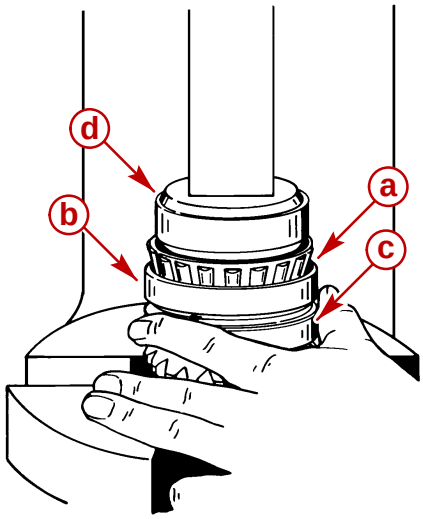
22393

a - Driver Tool (91-90774)
b - Bearing Cone
c - Drive Gear

2. Place the bearing cup onto the bearing cone.
3. Place the large bearing spacer onto the bearing cup.
4. Place the second bearing cup onto the spacer.

IMPORTANT: Do not over-press the second bearing cone, as damage to one or both of the bearings could occur. If an over-pressed condition occurs (the spacer does not move freely), completely disassemble the bearings from the gear and start again.

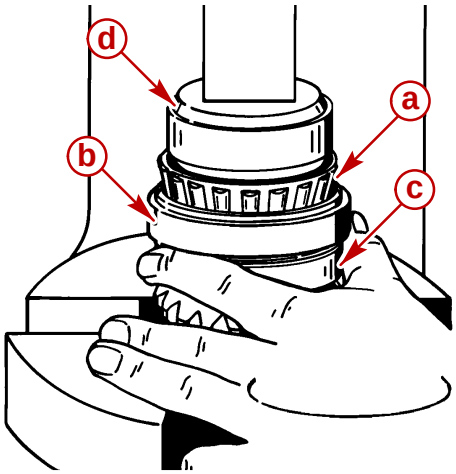
5. Press the bearing cone (positioned as shown in the next figures) onto the pinion gear until the bearing rollers make light contact with the bearing cup.



22393

Models With Serial Numbers Prior To 0L100009

a - Bearing Cone
b - Bearing Cup
c - Spacer (Must Move Freely)
d - Suitable Mandrel - Must Push On Inner Bearing Race



75631

Models With Serial Numbers 0L100009 and Later

a - Bearing Cone
b - Bearing Cup
c - Spacer (Must Move Freely)
d - Suitable Mandrel – Must Push On Inner Bearing Race

U-joint Subassembly

INSPECTION

1. Inspect the splines on both ends for a twisted or cracked condition. Replace the appropriate parts if either condition is found.
2. If U-joint knocking is suspected, inspect the bearing caps for roughness and excessive side-to-side play. Replace the appropriate parts if either condition is found.
3. Inspect the crosses and bearings for roughness and excessive side-to-side play. Replace the appropriate parts if either condition is found.

DISASSEMBLY

IMPORTANT: If any of the crosses and bearings are to be reused, liberally lubricate the crosses with Quicksilver U-joint and Gimbal Bearing Grease to help retain the needle bearings in the caps during disassembly.

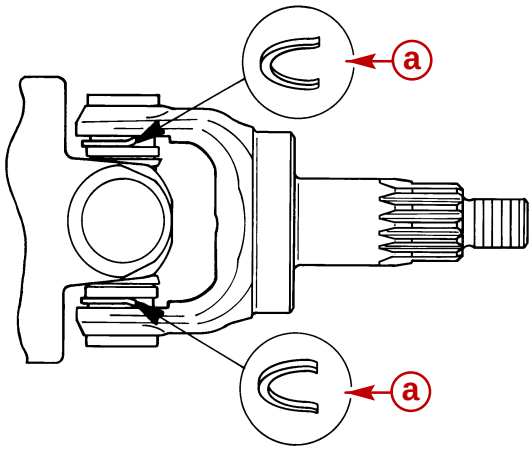
NOTE: *The U-joint has been changed to a Perm-A-Lube U-joint assembly following the serial number 0D899000. The serial numbers prior to 0D899000 do not use the Perm-A-Lube U-joint.*

NOTE: *If by previous inspection, it has been determined that the U-joint is not in need of servicing, skip this disassembly and the following reassembly section.*

⚠ CAUTION

Eye protection must be worn when performing the following procedure. Failure to do so may cause personal injury.

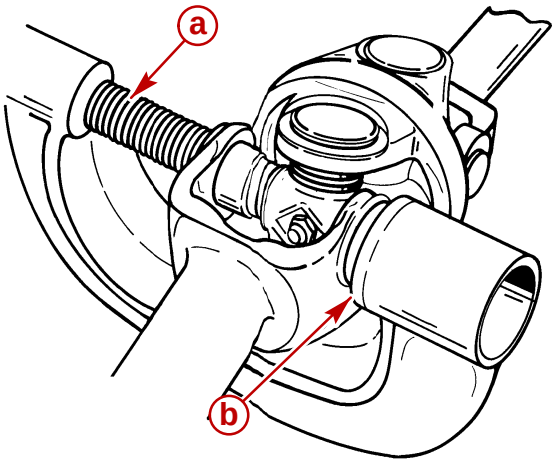
1. Remove the C-rings by driving them off with a punch and a hammer.



22179

a - C-ring

2. Using the adaptor and a U-joint press, press one bearing cap in until the opposite bearing is pressed out into the adaptor. Remove the loose bearing cap.



22180

a - U-joint Press
b - Adaptor (91-38756)

3. Turn the U-joint assembly 180 degrees and press on the cross until the second bearing is pressed out into the adapter. Remove each pair of bearing caps in this manner.

INSPECTION

1. Clean all components (except the bearing caps and bearings) with a suitable solvent and dry thoroughly with compressed air.
2. Inspect the bearing cap seals for damage or deterioration. Replace bearing caps and crosses if either condition is found.

IMPORTANT: If the crosses are found to be in need of replacement, all the needle bearings, caps and cross must be replaced. Do not reuse any individual component(s) of a cross assembly.

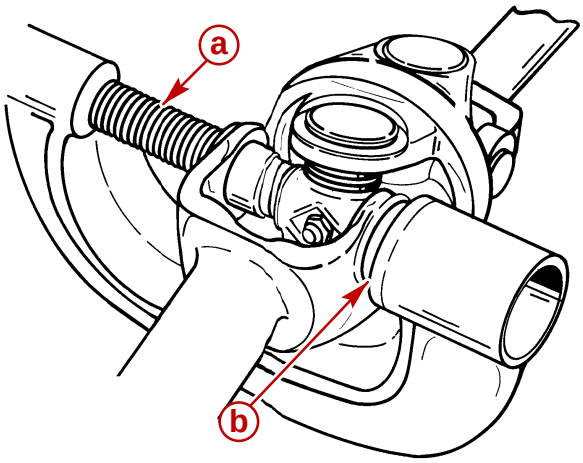
3. Inspect the bearing surfaces of the crosses for hairline fractures, excessive pitting, wear, grooves, scores, uneven wear, discoloration (from overheating) and embedded particles, or breakage. Replace the appropriate cross assembly (cross, bearings and caps) if any of these conditions exist.
4. Inspect all remaining components for excessive wear or damage. Replace the appropriate components if either is found.

REASSEMBLY

IMPORTANT: Use only Quicksilver U-joint and Gimbal Bearing Grease for lubricating the U-joint bearings. The use of any other lubricant will decrease the life of the bearings.

NOTE: *When initially positioning the crosses in the yoke, be sure that the grease fittings are facing toward the coupler (long end) yoke.*

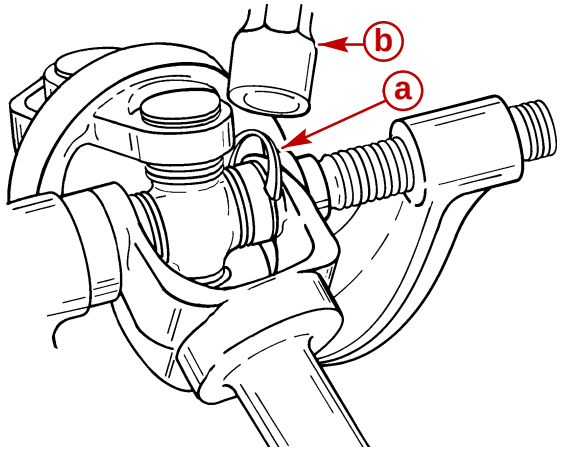
1. Using the adaptor and a U-joint press, assemble the cross between the yoke and press one bearing cup in until it is **nearly** through its yoke.



22180

a - U-joint Press
b - Adaptor (91-38756)

2. Turn the U-joint assembly 180 degrees and press the other bearing cup on until both cups are positioned correctly. Assemble each pair of bearings in this manner.
3. Install the C-rings into the groove of the bearing caps. Ensure that all of the C-rings are properly seated.



22182

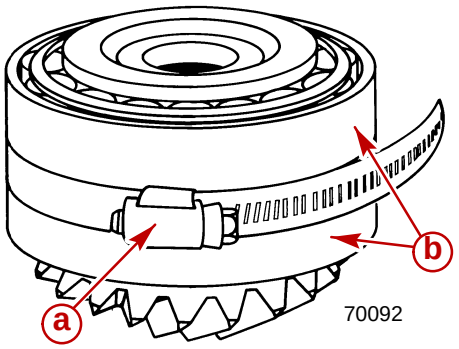
a - C-ring
b - Hammer

4. Repeat Step 1 for all pairs of bearings.
5. Lubricate the grease fittings with Quicksilver U-joint and Gimbal Bearing Grease.

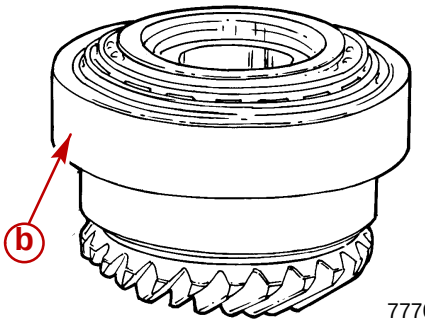
U-joint Assembly

REASSEMBLY

1. **On Models With Serial Numbers Prior To 0L100009:** temporarily install a hose clamp on the bearing assembly to keep the bearing cups aligned with the spacer while accomplishing the next step.



70092

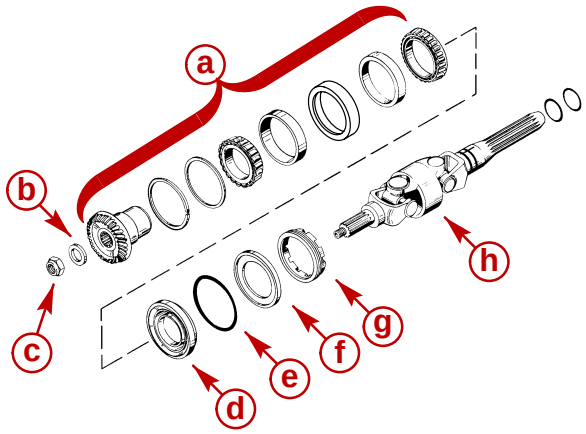


77709

. . . . . Earlier Style . . . . . Later Style

a - Hose Clamp
b - Bearing Cups

2. Assemble the retainer ring, thrust washer, O-ring and oil seal carrier. Then assemble the gear/bearing assembly, the washer and the nut. Tighten the nut finger tight.

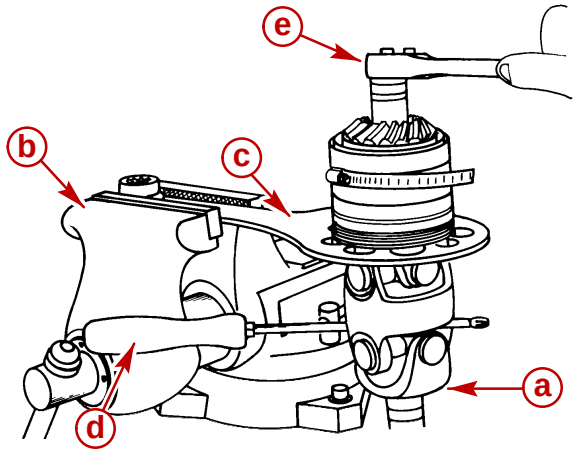


75632

a - Gear Assembly
b - Washer
c - Nut
d - Oil Seal Carrier
e - O-ring
f - Thrust Washer
g - Retainer Ring
h - U-joint Assembly

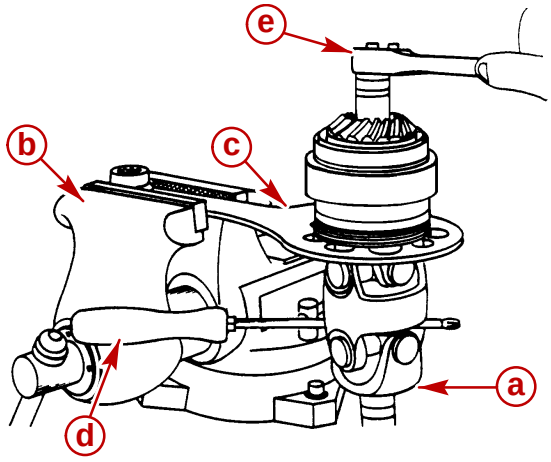
3. Place the U-joint into the U-joint retainer tool.

4. Insert a suitable tool, such as a screwdriver, between the U-joint yokes as shown in the next figure, to prevent the U-joint from rotating when turning down the pinion nut. Turn the pinion nut down until the preload is on the bearings. Remove the screwdriver or holding device.



70210

Models With Serial Numbers Prior To 0L100009



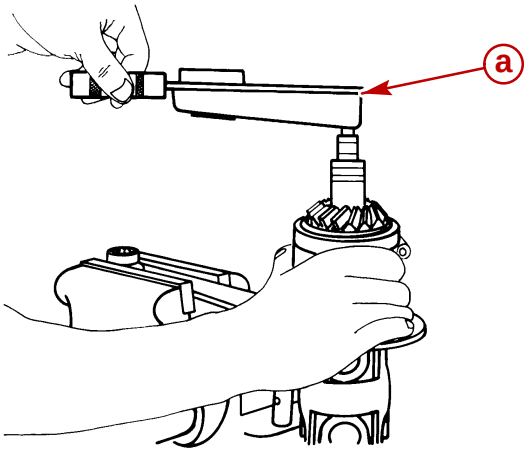
75633

Models With Serial Numbers After 0L100009

a - U-joint Assembly
b - Vice
c - U-joint Retainer Tool (91-17256)
d - Screwdriver
e - Socket and Ratchet Wrench

SETTING BEARING PRELOAD

1. Set the preload by holding the bearings and turning the pinion nut at least two full revolutions. Check preload by turning the pinion nut very slowly a third time and, while turning, take a reading of the preload. If the preload is under the specification of 8 lb-in. (0.9 Nm) [5.25 lb-in. (0.55 Nm) for used bearings], torque the pinion nut slightly more as instructed in the previous step. Recheck preload. Continue this sequence until the proper preload is achieved.



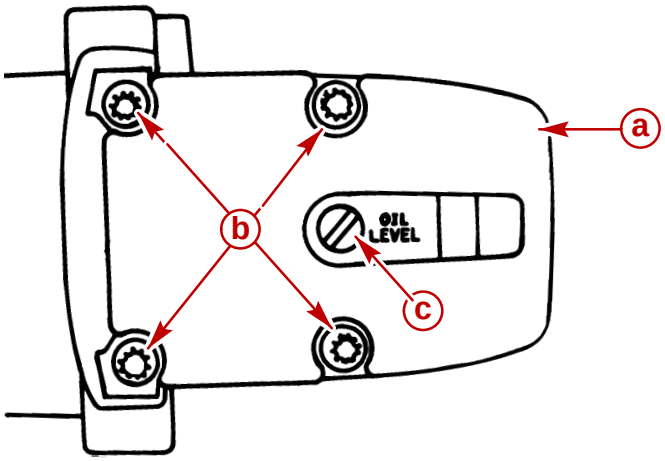
70212

a - Torque Wrench

IMPORTANT: If the preload goes over the specified limit of 8 lb-in. (0.9 Nm) [5.5 lb-in. (0.55 Nm) for used bearings], the bearings must be totally separated from the gear and reassembled following the appropriate previous instructions. Failure to follow these instructions will cause premature failure of the unit.

Top Cover Subassembly

INSPECTION



70118

a - Top Cover
b - Screws
c - Dipstick (Early Models)

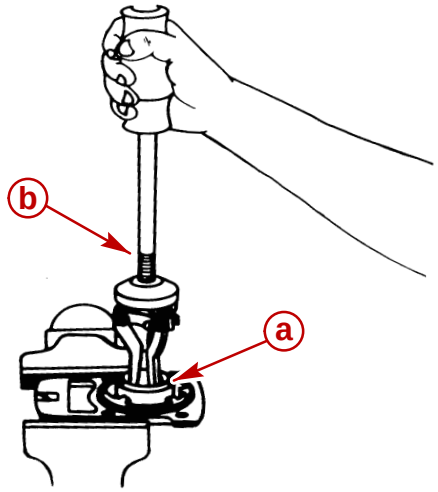
1. Remove and inspect the O-ring on the top cover for damage or deterioration. Replace it if either of these conditions exist.

2. Remove the top cover bearing cup and shim(s). Measure and make a note of the thickness of the shim pack. The shim(s) may be reused if they are not damaged.
3. Clean the top cover with a suitable solvent and a hard bristle brush. Ensure that all sealants and locking agents are removed. Dry the top cover thoroughly using compressed air.
4. Inspect the oil passage to ensure that it is clean and free of debris.
5. Inspect the bearing cup in the top cover for pits, grooves, scores, uneven wear, discoloration from overheating, or embedded particles. Replace it and the small bearing on the end of the upper drive shaft if any of these conditions exist.
6. Ensure that the bearing cup is not spinning in the top cover bore. If this condition exists, replace the top cover, the bearing cup and the bearing on the upper drive shaft.

DISASSEMBLY

NOTE: *Disassembly of the top cover is for replacement of the bearing cup or changing the thickness of the shim pack for adjusting the upper driven gear bearing preload or gear location.*

1. Remove the top cover bearing cup and shim(s). Measure and make a note of the thickness of the shim pack. The shim(s) may be reused if they are not damaged.
2. Inspect the top cover bearing cup bore for evidence of the bearing cup spinning in the bore. If this condition exists, replace the top cover, the bearing cup and the small bearing on the upper drive shaft.



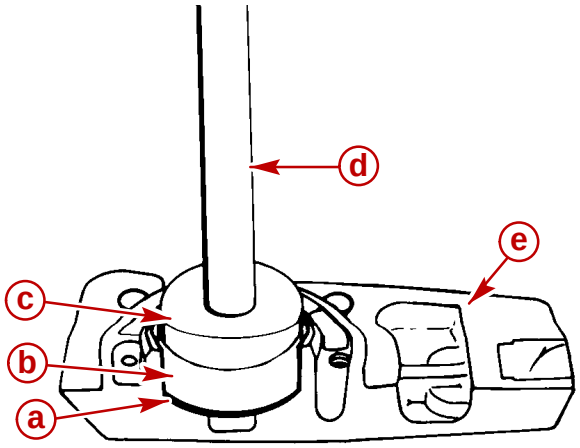
70127

a - Bearing Cup
b - Slide Hammer Puller (91-34569A1)

REASSEMBLY

NOTE: *If installing the top cover bearing race for the first time, use the same thickness of shims that were removed or a .015 in. (0.38 mm) shim pack if the original shim pack thickness is not known.*

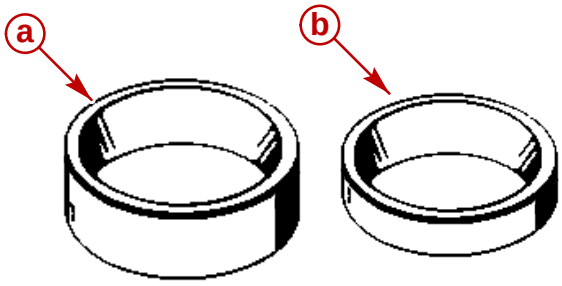
1. Lubricate the top cover bore with Quicksilver High Performance Gear Lube
2. Place the shims(s) into the top cover bore.
3. Install the bearing cup into the top cover using the tools as shown in the following figure.
4. Reinstall the top cover O-ring.



70701

a - Shims
b - Bearing Cup
c - Bearing Cup Driver (91-38918) Used With 31-61100A1 Bearing Or Bearing Cup Driver (91-808053) Used With 31-32575A1 Bearing
d - Driver Rod (91-37323)
e - Top Cover

NOTE: *The later style bearing cup is thinner than the earlier style cup.*

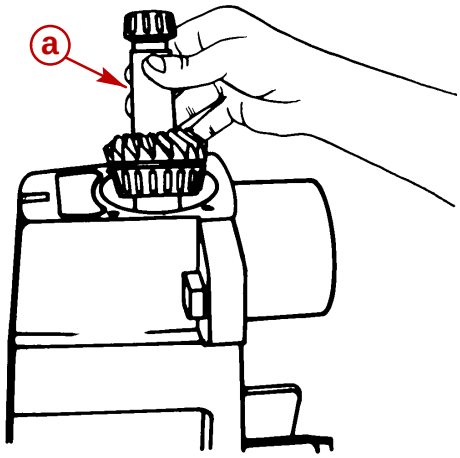


75240

a - Earlier Style Bearing Cup 1.938 in Diameter (Prior To S/N OF680000)
b - Later Style Bearing Cup 1.781 in. Diameter (S/N 680000 And Above)

Upper Driven Gear Subassembly

DISASSEMBLY



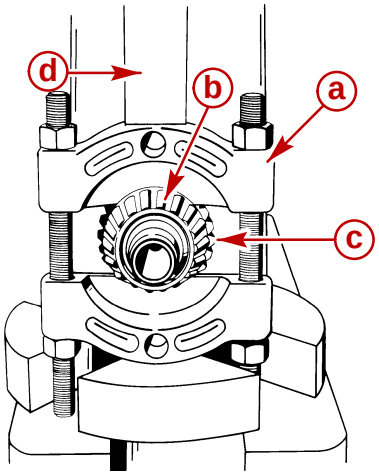
70124

a - Driven Gear Assembly

1. Clean the bearing race in the drive shaft housing and dry it thoroughly. Inspect it for excessive pits, grooves, scores, uneven wear, discoloration due to excessive heat and/or embedded particles. Replace the bearing and the bearing cup in the drive shaft housing (explained later in this section) if any of these conditions exist.

NOTE: *Disassembly of the upper driven gear assembly is for replacement of components only.*

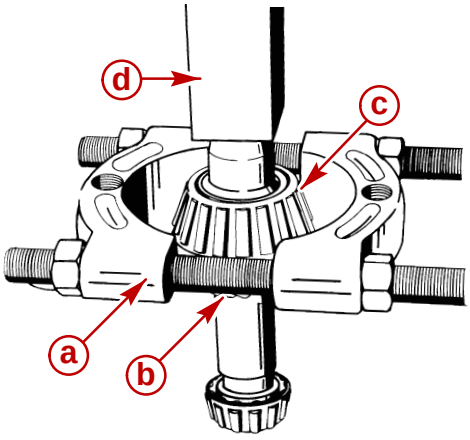
2. Position the Universal Puller Plate between the driven gear and the tapered roller bearing with the tapered side of the plate toward the roller bearing.
3. Press on the sides of plate until it bottoms out on the gear.



23265

a - Universal Puller Plate (91-37241)
b - Tapered Roller Bearing
c - Driven Gear
d - Arbor Press

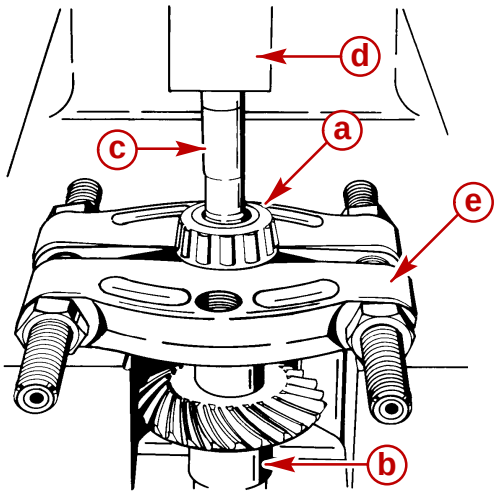
4. Reposition the plate and gear assembly and press the gear until the tapered roller bearing slides off. Ensure the puller plates are aligned on the press with the threaded rods on the support brackets of the press.



23264

a - Universal Puller Plate (91-37241)
b - Driven Gear
c - Tapered Roller Bearing
d - Arbor Press

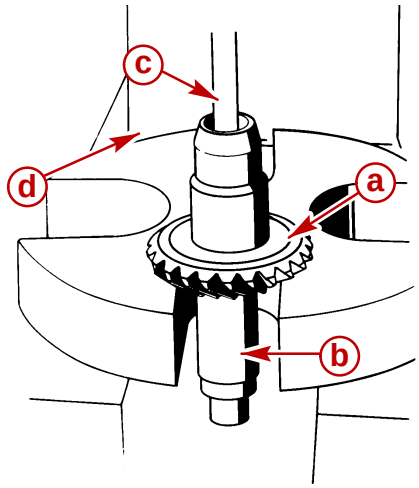
5. Reassemble the plate with the flat side of the plate toward the bearing and remove the small upper drive shaft tapered roller bearing using a suitable mandrel.



23265

a - Upper Drive Shaft Bearing (small)
b - Gear
c - Suitable Tool
d - Arbor Press
e - Universal Puller Plate (91-37241)

6. Press the driven gear from the upper drive shaft.



23266

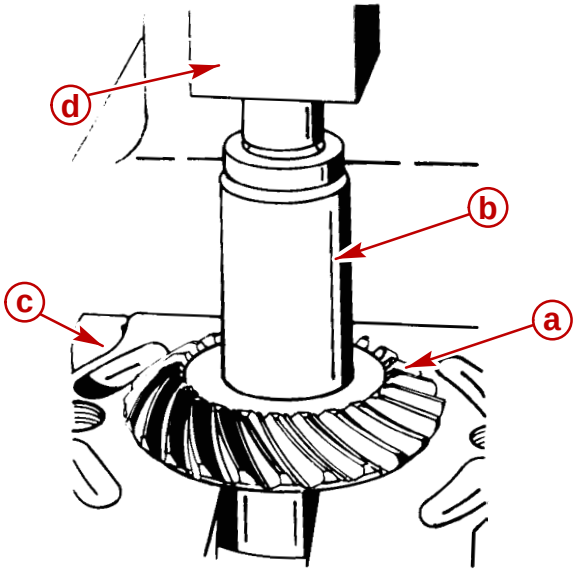
a - Driven Gear
b - Upper Drive Shaft
c - Suitable Tool
d - Arbor Press

INSPECTION

1. Clean all parts with a suitable solvent and dry them thoroughly with compressed air. Be careful not to spin the bearing.
2. Inspect the gear for pitting, chipped or broken teeth, hairline fractures and excessive or uneven wear. Replace both the drive (pinion) and the driven gear if any of these conditions exist.
3. Inspect the gear hub for evidence of the bearing spinning. Replace the tapered roller bearing, the driven gear and the pinion gear on the U-joint if any evidence of spinning is found.
4. Inspect the upper drive shaft for damage, hairline fractures and evidence of the gear spinning on the shaft. Replace the upper drive shaft, the driven gear and the pinion gear on the U-joint if any of these conditions are found.
5. Inspect the upper drive shaft to ensure that the hole through the center of the shaft is clean and clear. Clean out the hole if it has any debris.

REASSEMBLY

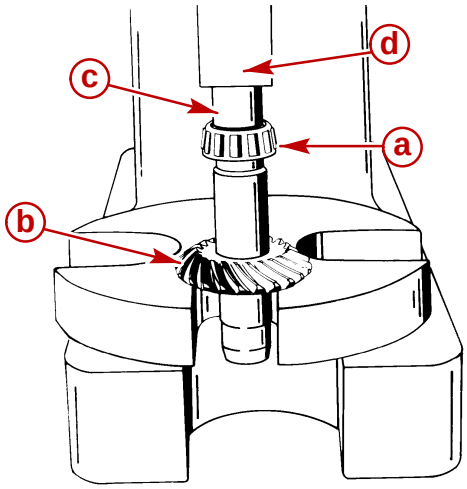
1. Press the upper drive shaft onto the driven gear until it bottoms.



23264

a - Driven Gear
b - Upper Drive Shaft
c - Universal Puller Plate (91-37241)
d - Arbor Press

2. Press the small tapered roller bearing onto the upper drive shaft until it bottoms out on the shaft.



23264

a - Tapered Roller Bearing (large)
b - Driven Gear
c - Suitable Tool (An Old Upper Driven Gear Bearing Inner Race)
d - Arbor Press

Drive Shaft Housing Reassembly

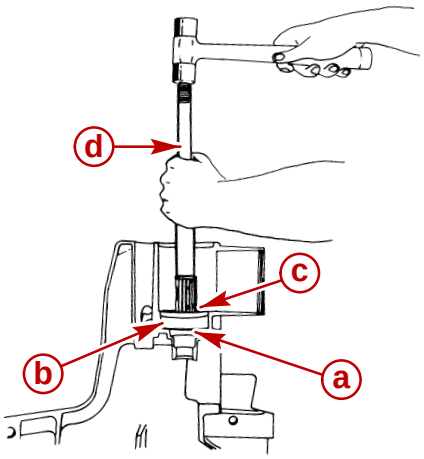
Drive Shaft Housing Inspection

1. Inspect the locating pin holes on the drive shaft housing (at the gear housing mating surface) to ensure that they are not elongated. Elongation of the holes may cause the drive shaft to break because the housings may not align properly when assembled.

Installation

NOTE: *If installing the upper driven gear bearing cup for the first time use the same thickness of shims that were removed or approximately a .015 in. (0.38mm) shim pack if the original shim pack thickness is not known.*

1. Lubricate the bore in the drive shaft housing (into which the upper driven gear bearing cup is to be installed) with Quicksilver High Performance Gear Lube.
2. Place the shim(s) into the bore of the drive shaft housing.
3. Install the upper driven gear bearing cup as shown below.



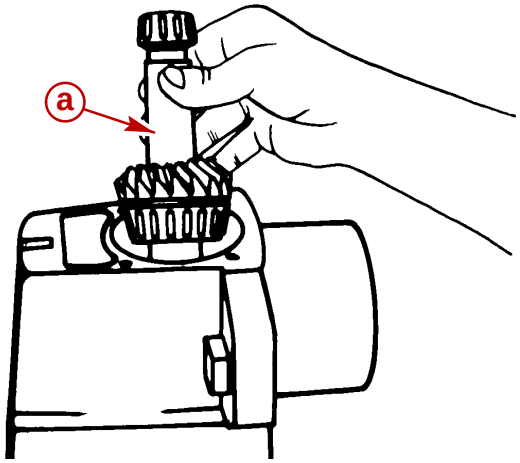
70445

a - Shims
b - Bearing Cup
c - Bearing Cup Driver (91-33493)
d - Driver Rod (An Old Propeller Shaft Shown)

IMPORTANT: Lightly lubricate the gears, bearings, seals and O-rings with Quicksilver High Performance Gear Lube before installing. Bearings and gears must be lubricated to obtain accurate preload readings.

IMPORTANT: The top cover screws must be torqued to 20 lb-ft (27 Nm), to properly check the upper drive shaft bearing preload.

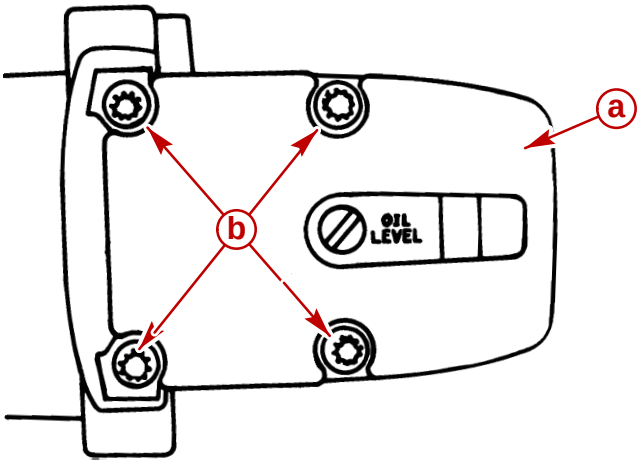
4. Lightly lubricate both of the bearings on the upper driven gear assembly with Quicksilver High Performance Gear Lube and install the upper driven gear assembly into the drive shaft housing.



70124

a - Upper Driven Gear Assembly

5. Install the top cover and torque the screws 20 lb-ft (27 Nm).

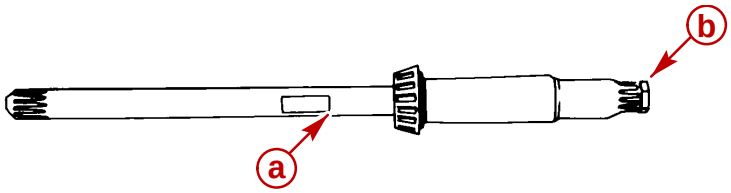


70118

a - Top Cover
b - Screws (4)

6. Check and adjust the upper driven gear bearing preload as follows:

   a. Insert a drive shaft with a pinion nut assembled to it into the upper driven gear splines.



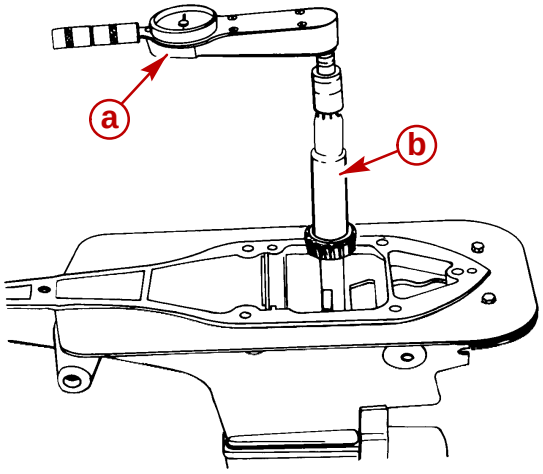
70702

a - Drive Shaft
b - Pinion Nut

   b. Using an inch - pound torque wrench, rotate the drive shaft clockwise at least two full turns. Check the preload by rotating the drive shaft very slowly in the same direction a third time and while rotating, take a reading of the preload. The preload reading should be within specification as follows:

New Bearings	6-10 in. lb. (0.7-1.7 Nm)
Used Bearings	3-7.5 in. lb. (0.3-0.8 Nm)

NOTE: *The bearings are considered used if spun under load once.*



70703

a - Torque Wrench
b - Drive Shaft

If the preload did not check to specification follow the appropriate instructions:

If The Preload Is Higher Than Specified: remove shims from beneath the top cover bearing cup. Reinstall the top cover and recheck the preload as outlined above.

If The Preload Is Lower Than Specified: add shims beneath the top cover bearing cup. Reinstall the top cover and recheck the preload as outlined above.

   c. Continue this process until the preload check is within specification.

Assembly and Checking Driven Gear Location

IMPORTANT: The upper driven gear preload must be to specification before checking the upper driven gear location.

1. Install the upper driven gear shimming tool into the drive shaft housing with the appropriate opening (see chart following) toward the upper driven gear and check the upper driven gear location as follows:

1997 1/2 AND EARLIER MODELS (S/N 0K999999 AND BELOW)

Shimming Tool 91-60526	
Overall Drive Unit Gear Ratio	**Tool Position**
1.47:1, 1.50:1	Z
1.65:1	X
1.84:1	Y
1.98:1	Y
2.40:1	Y

1998 AND LATER (S/N 0L100009 AND ABOVE)

Shimming Tool 91-854377	
Overall Drive Unit Gear Ratio	Tool Position
1.47:1	C
1.62:1	A
1.81:1	B
1.94:1	B
2.0:1	A
2.40:1	B

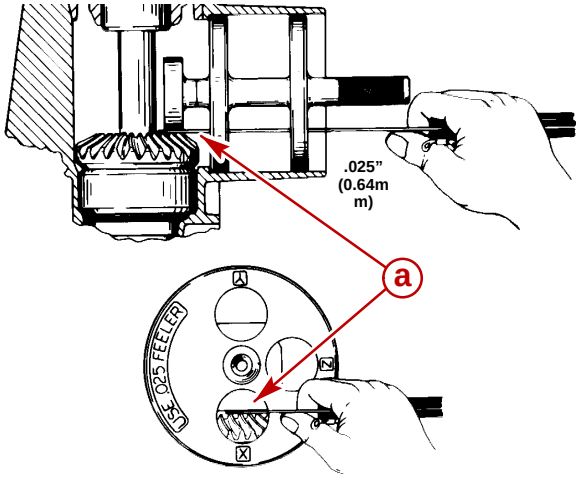
IMPORTANT: The following procedure must be done exactly as stated to properly check the upper driven gear location.

a. Position the gear so that at least two full teeth are centered on the gauging surface. One full tooth must be on each side of the gauging surface centerline. Insert a .025 in. (0.64 mm) feeler gauge between one of the teeth and the gauging surface.

b. Rotate the shimming tool until one side of the gauging surface contacts the feeler gauge and a slight drag is felt on the feeler gauge.

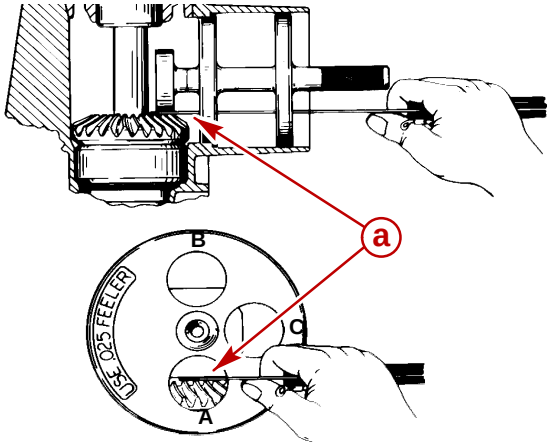
c. Without moving the shimming tool, remove the feeler gauge and re-insert it between the other tooth and the gauging surface.

If The Feeler Gauge Can Be Inserted With Only A Slight Drag: the shimming is correct.



23012

Shimming Tool 91-60526



75660

Shimming Tool 91-854377

a - Feeler Gauge - .025 in. (0.635 mm)

Adjusting Gear Location

IMPORTANT: If the feeler gauge can be inserted without any drag; the shimming is incorrect (the gear is to far away from the shimming tool). Repeat Steps a, b and c (as previously described) with progressively thicker feeler gauges until the gear location is known.

Example: (the gear is too far away from the shimming tool) the gear location is too low.		
If feeler gauge thickness is.	.30 in.	0.760 mm
Subtract specification	.025 in.	0.635 mm
you get	.005 in.	0.125 mm
Add this amount of shims beneath the driven gear assembly race in the drive shaft housing and subtract the same amount of shims from beneath the top cover bearing race.		

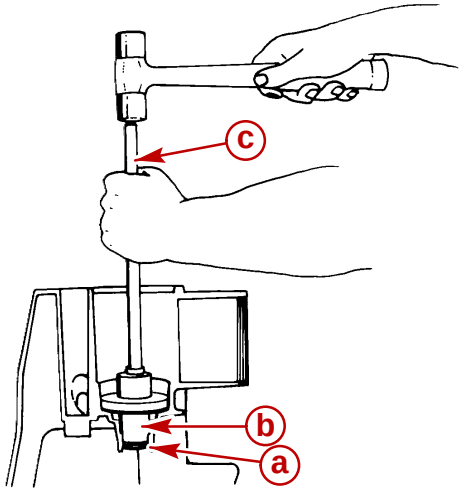
***If The Feeler Gauge Cannot Be Inserted On Both Sides Without Moving The Shimming Tool:** the shimming is incorrect (the gear is too close to the shimming tool). Repeat Steps a, b and c (as described on page 3A-23) with progressively thinner feeler gauges until the gear location is known.

Example: (the gear is too close to the shimming tool) the gear location is too high.		
Specification	.025 in.	0.635 mm
Subtract feeler gauge thickness:	.020 in.	0.510 mm
you get	.005 in.	0.125 mm
Subtract this amount of shims beneath the upper gear assembly race in the drive shaft housing and add the same amount of shims beneath the top cover bearing race.		

1. Reassemble the top cover as outlined in “Top Cover Assembly,” ‘Component Reassembly’ section and add or subtract the appropriate quantity of shims beneath the top cover bearing race.
2. Remove the upper driven gear assembly and remove the upper driven gear bearing cup as outlined in “Upper Driven Gear Bearing Cup,” ‘Removal’ section and add or subtract the appropriate quantity of shims beneath the upper driven gear bearing cup race.
3. Install the upper driven gear bearing cup.
4. Install the upper driven gear assembly and recheck preload.
5. Recheck the upper driven gear location.
6. Remove the top cover and upper driven gear assembly and upper driven gear bearing cup.

Seal Installation

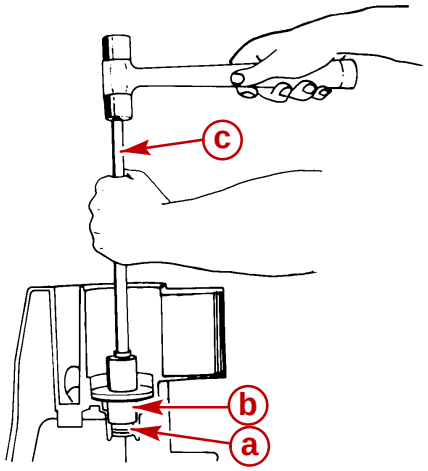
1. Lightly oil the bore with Quicksilver High Performance Gear Lube.
2. Assemble the first seal to the long end of the driver tool with the lip (spring) side facing away from the driver shoulder and press the seal into the bore.



70705

a - Oil Seal (Lip Down)
b - Drive Tool (91-817570) (Long End)
c - Driver Rod (91-37323)

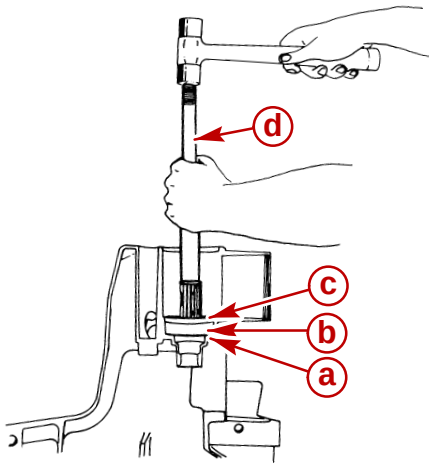
3. Lightly oil the bore again with Quicksilver High Performance Gear Lube.
4. Assemble the second seal to the short end of the driver tool with the lip (spring) side facing toward the driver shoulder and press the seal into the bore.



70706

a - Oil Seal (Lip Up)
b - Drive Tool (91-817570) (Short End)
c - Driver Rod (91-37323)

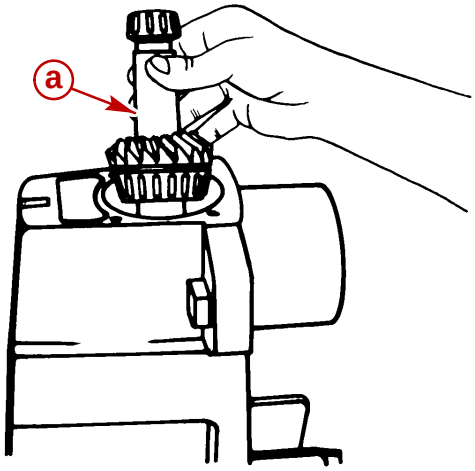
5. Reinstall the driven gear bearing cup and shims.



70445

a - Shims
b - Bearing Cup
c - Bearing Cup Driver (91-33493)
d - Driver Rod (An Old Propeller Shaft Shown)

6. Completely fill the space between the two seals with 2-4-C Marine Lubricant with Teflon and install the upper driven gear assembly. Do not install the top cover at this time.

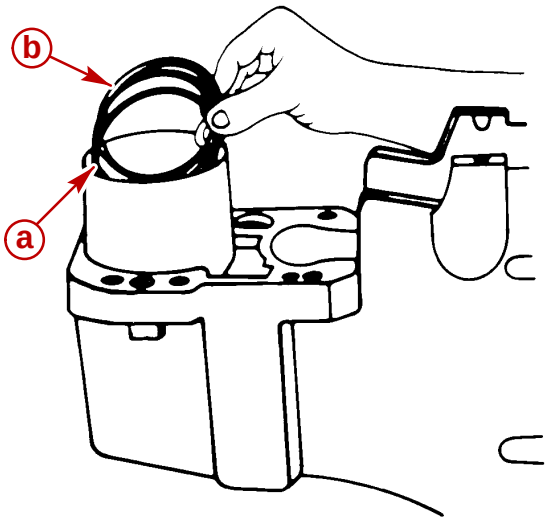


70124

a - Upper Driven Gear Assembly

NOTE: *Install the same thickness of shims as were originally removed during disassembly. If original shim thickness is not known, start with approximately a .015 in. (0.38 mm) shim pack.*

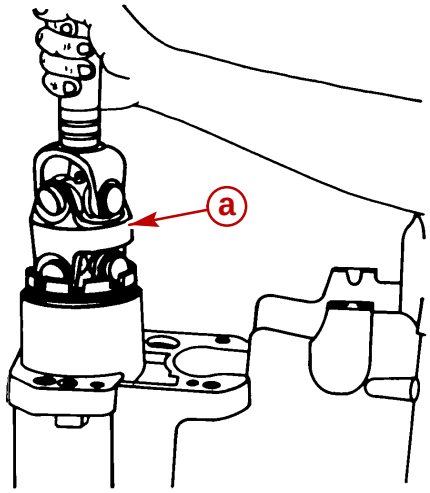
7. Place the spacer ring into the drive shaft housing U-joint bore and place the shims(s) into the bore.



70123

a - Spacer Ring (Installed First)
b - Shims

8. Lightly lubricate the drive shaft housing U-joint bore with Quicksilver High Performance Gear Lube.
9. Thoroughly lubricate the U-joint retainer threads on the U-joint retainer (not in the drive shaft housing bore) with Quicksilver Special Lubricant 101.
10. Install the U-joint assembly straight into the drive shaft housing and screw down the retainer using the following procedure.



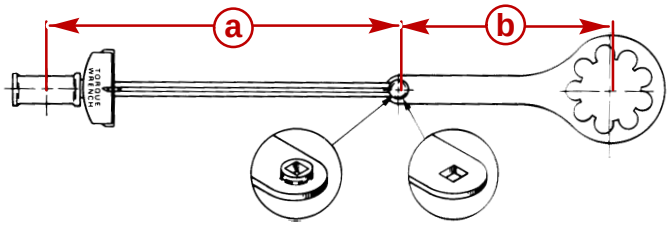
70122

a - U-joint Assembly

NOTE: *The torque wrench reading will be less than the actual torque being applied to the retainer, due to the torque reading being taken through the retainer wrench. Use the following procedure to torque the retainer to 200 lb-ft (271 Nm).*

11. Measure the length of the torque wrench as follows:
    a. On beam type torque wrenches, measure from the square drive to the fulcrum (pivot) point of the handle.
    b. On click-stop or dial type torque wrenches, measure from the square drive to the reference mark on the handle (marked with 2 bands, a line, etc.).
12. Use the following chart to determine the torque wrench reading required to properly torque the retainer to 200 lb-ft (271 Nm).

Torque Wrench Length In Inches (cm)	Torque Wrench Reading, in lb-ft (Nm) to achieve 200 lb-ft (271 Nm) of torque
15 (38)	111 (151)
16 (41)	114 (155)
17 (43)	117 (159)
18 (46)	120 (163)
19 (48)	123 (167)
20 (51)	125 (170)
21 (53)	127 (172)
22 (56)	129 (175)
23 (58)	131 (178)
24 (61)	133 (180)
25 (64)	135 (183)
26 (66)	136 (184)
27 (69)	138 (187)
28 (71)	140 (190)
29 (74)	141 (191)
30 (76)	143 (194)
31 (79)	144 (195)
32 (81)	145 (197)
33 (84)	147 (200)
34 (86)	148 (201)
35 (89)	149 (202)
36 (91)	150 (203)



26363

a - Torque Wrench Length
b - 12 in. retainer Wrench

a. Torque the retainer until the torque reading for your length of torque wrench is attained.

Checking and Adjusting Drive Gear Location

1. Install the drive gear shimming tool into the drive shaft housing with the appropriate opening (see chart following) toward the drive gear. Check the gear location as follows:

Shimming Tool 91-60523	
Overall Drive Unit Gear Ratio	**Tool Position**
1.47 or 1.50:1	Z
1.62 or 1.65:1	Y
1.81 or 1.84:1	Y
1.94 or 1.98:1	Y
2.0:1	Y
2.40:1	Y

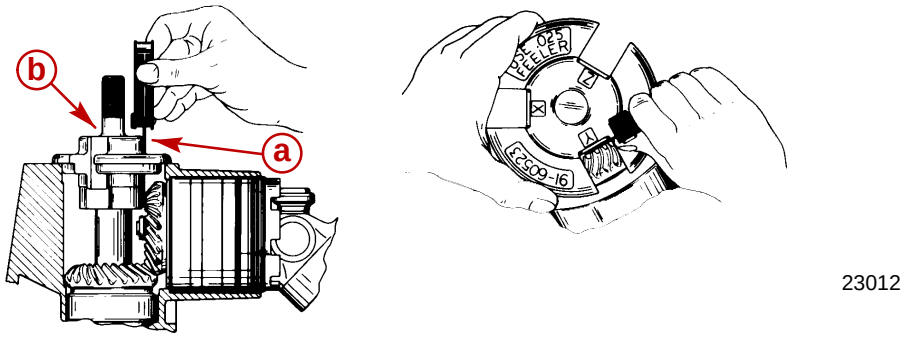
IMPORTANT: The following procedure must be done <u>exactly</u> as stated to properly check the upper driven gear location.

a. Position the gear so that at least two full teeth are centered on the gauging surface. One full tooth must be on each side of the gauging surface centerline. Insert a .025 in. (0.64 mm) feeler gauge between one of the teeth and the gauging surface.

b. Rotate the shimming tool until one side of the gauging surface contacts the feeler gauge and a slight drag is felt on the feeler gauge.

c. Without moving the shimming tool, remove the feeler gauge and re-insert it between the other tooth and the gauging surface.

NOTE: If the feeler gauge can be inserted with only a slight drag: *the shimming is correct (the gear is the correct distance from the shimming tool).*



23012

a - Feeler Gauge
b - Shimming Tool

ADJUSTING PINION GEAR LOCATION (U-JOINT ASSEMBLY)

NOTE: If the feeler gauge inserts with no drag: *the shimming is incorrect (the gear is too far away from the shimming tool). Repeat Steps a, b and c (as described previously) with progressively thicker feeler gauges until the gear location is known.*

Example: the gear location is too high (the gear is too far away from the shimming tool),		
If feeler gauge thickness is:	.030 in.	0.760 mm
Subtract specification	.025 in.	0.635mm
you get	.005 in.	0.125 mm
Remove the U-joint and subtract this amount of shims, then reinstall the U-joint.		

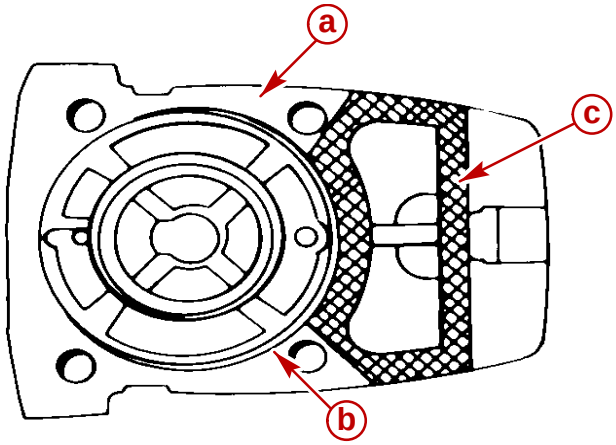
NOTE: If the feeler gauge cannot be inserted on both sides without moving the shimming tool: *the shimming is incorrect (the gear is too close to the shimming tool). Repeat Steps a, b and c above with progressively thinner feeler gauges until the gear location is known.*

Example: the gear location is too low (the gear is too close to the shimming tool)		
Specification	.025 In.	0.635 mm
Subtract feeler gauge thickness:	.020 In.	0.510mm
you get	.005 In.	.0125 mm
Add this amount of shims to position gear to its proper location.		

2. Recheck the pinion gear location as outlined previously and readjust if necessary.

Final Reassembly

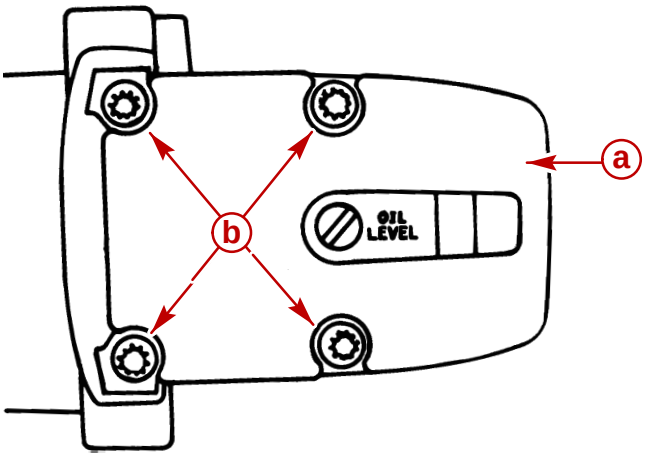
1. Assemble the O-ring to the top cover.
2. Apply Quicksilver Perfect Seal to the top cover (or the drive shaft housing) in the area highlighted in the next figure.



70725

a - Top Cover
b - O-ring
c - Quicksilver Perfect Seal

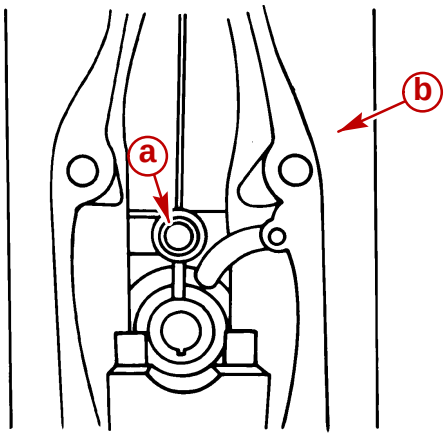
3. Install the top cover and torque the screws to 20 lb-ft (27 Nm).



70118

a - Top Cover
b - Screws

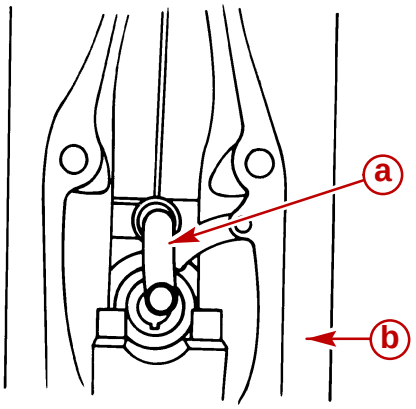
4. Install the rubber seal into the drive shaft housing.



70125

a - Rubber Seal
b - Drive Shaft Housing

5. Lubricate the end of the water tube (that goes into the drive shaft housing) with Quicksilver 2-4-C Marine Lubricant with Teflon. Install the water tube into the rubber seal in the drive shaft housing. Make sure that the tube is positioned with the bend towards the forward end of the unit and the longest straight section toward the gear housing mating surface.



70126

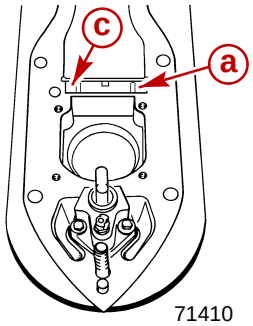
a - Water Tube (Correctly Positioned)
b - Drive Shaft Housing

Joining Drive Shaft Housing/Gear Housing

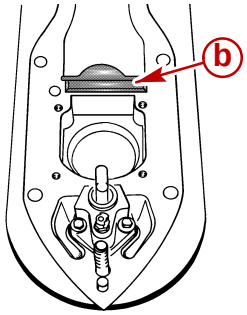
1. Lubricate the end of the water tube (in the drive shaft housing) and the splines of the drive shaft with Quicksilver 2-4-C Marine Lubricant with Teflon.

NOTE: *The aluminum dam in the gear housing has been changed to a rubber filler plug. If the aluminum water pump dam in the gear housing has become corroded or damaged, it can be replaced with the rubber filler plug.*

IMPORTANT: Ensure that the drain hole of the aluminum water pump dam is not clogged with any foreign material. Damage may occur if passage is blocked.



71410

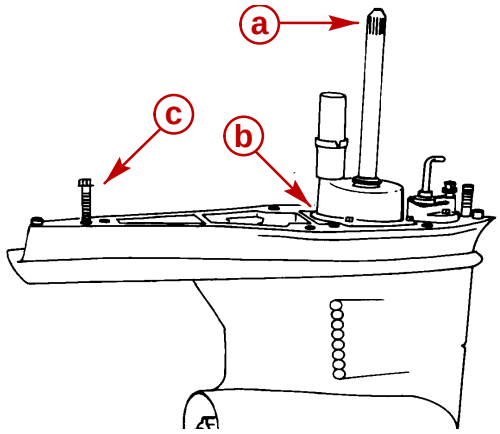


71436

a - Aluminum Dam
b - Rubber Filler Plug
c - Drain Hole

2. Units with an aluminum dam require a bead of Permatex Ultra Blue Silicone Sealant along the top of the dam. If rubber filler plug is present, it is not necessary to use this sealant.
3. To replace the aluminum dam if it has been removed and undamaged, place a bead of Permatex Ultra Blue Silicone Sealant down both sides of it.
4. Ensure that the water pump dam in the drive shaft housing is present and installed correctly. Ensure that all parts are present on the gear housing and the drive shaft housing.

IMPORTANT: Install the Trim Tab (or Anodic plate) bolt into the gear housing.

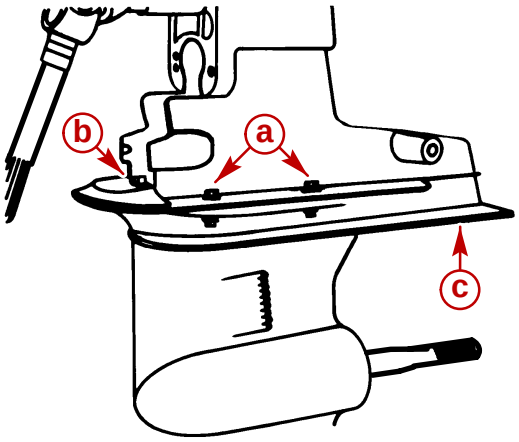


70710

a - Drive Shaft Splines
b - Sealant - Aluminum Dam Only
c - Trim Tab Bolt

5. Position the drive shaft housing straight above the gear housing. Align the water tube sleeve with the water tube and the drive shaft with the upper drive gear and assemble the drive shaft housing to the gear housing. It may be necessary to rotate the propeller shaft or the U-joint to align the drive shaft splines with the upper drive gear splines.

6. Assemble the front nut to the front stud of the unit.
7. Assemble the aft screw into the forward hole in the trim tab well of the gear housing.
8. Assemble the bolts, nuts and washers to the port and starboard sides of the unit.



70117

a - Nuts, Bolts, Washers
b - Nut
c - Screw

9. Assemble the trim tab (or anodic plate) and align it to the mark made previously on the gear housing. Torque the screw to 23 lb-ft (31 Nm).
10. Position drive unit so anti-ventilation plate is level.
11. Refill drive unit with gear lube. Refer to Section 1B.

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STERNDRIVE UNIT

Section 3B - Gear Housing Standard Rotation

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3 B

Standard Rotation Gear Housing Specifications

Torque Specifications

Description	Torque		
	lb-in.	lb-ft	Nm
Water Pump Body Screws	60		6.8
Pinion Gear Nut		70	95
Gear Housing-To-Drive Shaft Housing Screws		28	38
Gear Housing-To-Drive Shaft Housing Nuts		35	47
Trim Tab Screw Or Anodic Plate		23	31
Shift Shaft Bushing Screws	60		6.8
Drive Shaft Retainer		100	136
Bear Carrier Retainer		210	285
Oil Fill/Drain Screw	40		4.5
Propeller Nut [1]		55	75

[1]: Amount specified is MINIMUM.

Shimming Specifications

Description	Gear Location	
	inches	millimeters
Pinion Gear Height	.025	0.64
Forward Gear Backlash	.017-.028	0.43-0.71
Reverse Gear Backlash	.028-.060	0.71-1.32

Lubricants / Sealers / Adhesives

Description	Part Number
Quicksilver 2-4-C Marine Lubricant With Teflon	92-825407A12
3M Brand Adhesive	92-86166Q1
Quicksilver Needle Bearing Assembly Lubricant	92-825265A1
Quicksilver Perfect Seal	92-34227-1
Permatex Ultra Blue Silicone Sealant	Obtain Locally
Quicksilver Special Lubricant 101	92-13872A1
Loctite 271	92-809820
Quicksilver High Performance Gear Lube	92-850743A1

Special Tools

Description	Part Number
Backlash Indicator Rod (Used On All Gears except 14/28)	91-53459T
Backlash Indicator Tool (Used On 14/28 Gears)	91-78473
Bearing Carrier Retainer NutWrench	91-61069T
Driveshaft Bearing Preload Tool	91-14311A2
Belleville Washer	12-54048
Dial Indicator	91-58222A1
Dial Indicator Holding Tool	91-89897
Drive Shaft Nut Wrench	91-56775T
Driver, Bearing Cup	91-36577T
Drive Shaft Bearing Wrench	91-43506T
Flag 14/28	91-78473
Needle Bearing Driver	91-15755T
Needle Bearing Driver	91-33491
Oil Seal Driver	91-31108T
Oil Seal Driver	91-817569T
Pinion Gear Shimming Tool	91-56048T
Pinion Nut Adapter	91-61067A3
Drive Shaft Adapter	91-61077T
Puller Bolt	91-85716
Puller Jaws	91-46086A1
Slide Hammer Puller	91-34569A1
Torque Wrench	91-66274
Water Pump Alignment Pins	91-821571A1
Universal Bearing Removal And Installation Tool (**Includes the following items**)	91-31229A7
Needle Bearing Driver	91-15755T
Bearing Installation Tool	91-38628T

Special Tools (continued)

Description	Part Number
Collar	91-30366T-1
Needle Bearing Driver	91-32336
Driver Head	91-36569T
Prop Shaft Needle Bearing Driver	91-37311
Driveshaft Needle Bearing Driver	91-37312T
Needle Bearing Driver	91-52393T
Needle Bearing Driver Rod	91-37323
Nut	11-24156
Pilot Washer	91-36571T
Needle Bearing Pilot Washer	91-37324T
Pilot Washer	91-37350T
Puller Plate	91-29310
Gear Puller	91-36379
Puller Head	91-32325T
Bearing Installation Tool	91-38628T
Puller Head	91-52394
Puller Shaft	91-31229
Roller Bearing Removal and Installation Tool	91-37292
Washer	12-34961

*The 91-14311A2 Bearing Preload Tool is also used on Mercury and Mariner V-6 gear cases. Check your inventory before buying.

NOTE: *Water Pump Face Seal Tool is not available separately, 26-816575A2 is a kit part number which includes the tool and the face seal.*

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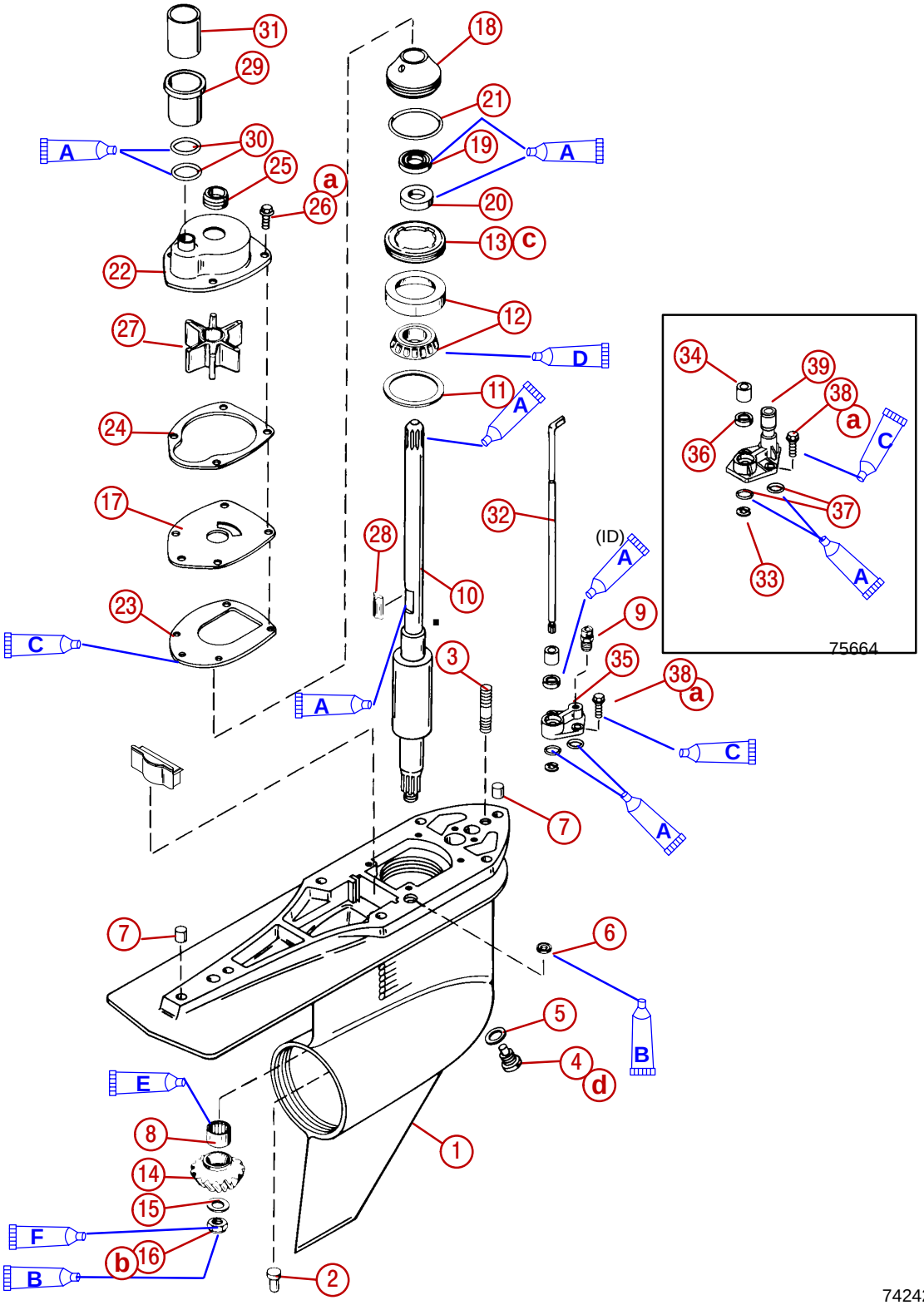
Standard Rotation Gear Housing Exploded Parts View

Drive Shaft Components



1 - Gear Housing	22 - Bushing Assembly (S/N 0L100009 And Above)
2 - Pin	23 - Water Pump
3 - Stud	24 - Gasket
4 - Oil Fill/Drain Screw	25 - Gasket
5 - O-ring Or Gasket	26 - Face Seal
6 - Seal	27 - Screw
7 - Dowel Pin	28 - Impeller
8 - Roller Bearing	29 - Key
9 - Speedometer Fitting	30 - Coupling
10 - Drive Shaft	31 - O-rings
11 - Shim	32 - Sleeve
12 - Bearing And Cup	33 - Shift Shaft
13 - Nut	34 - Retaining Ring
14 - Gear Drive	35 - Sleeve
15 - Washer	36 - Bushing Assembly (S/N Prior To 0L100009)
16 - Nut	37 - Oil Seal
17 - Face Plate	38 - O-rings
18 - Carrier	39 - Screw
19 - Oil Seal	
20 - Oil Seal	
21 - O-ring	

Lubricants/Sealers/Adhesives

A - Quicksilver 2-4-C Marine Lubricant with Teflon

B - 3M Brand Adhesive

C - Quicksilver Perfect Seal

D - Quicksilver High Performance Gear Lube

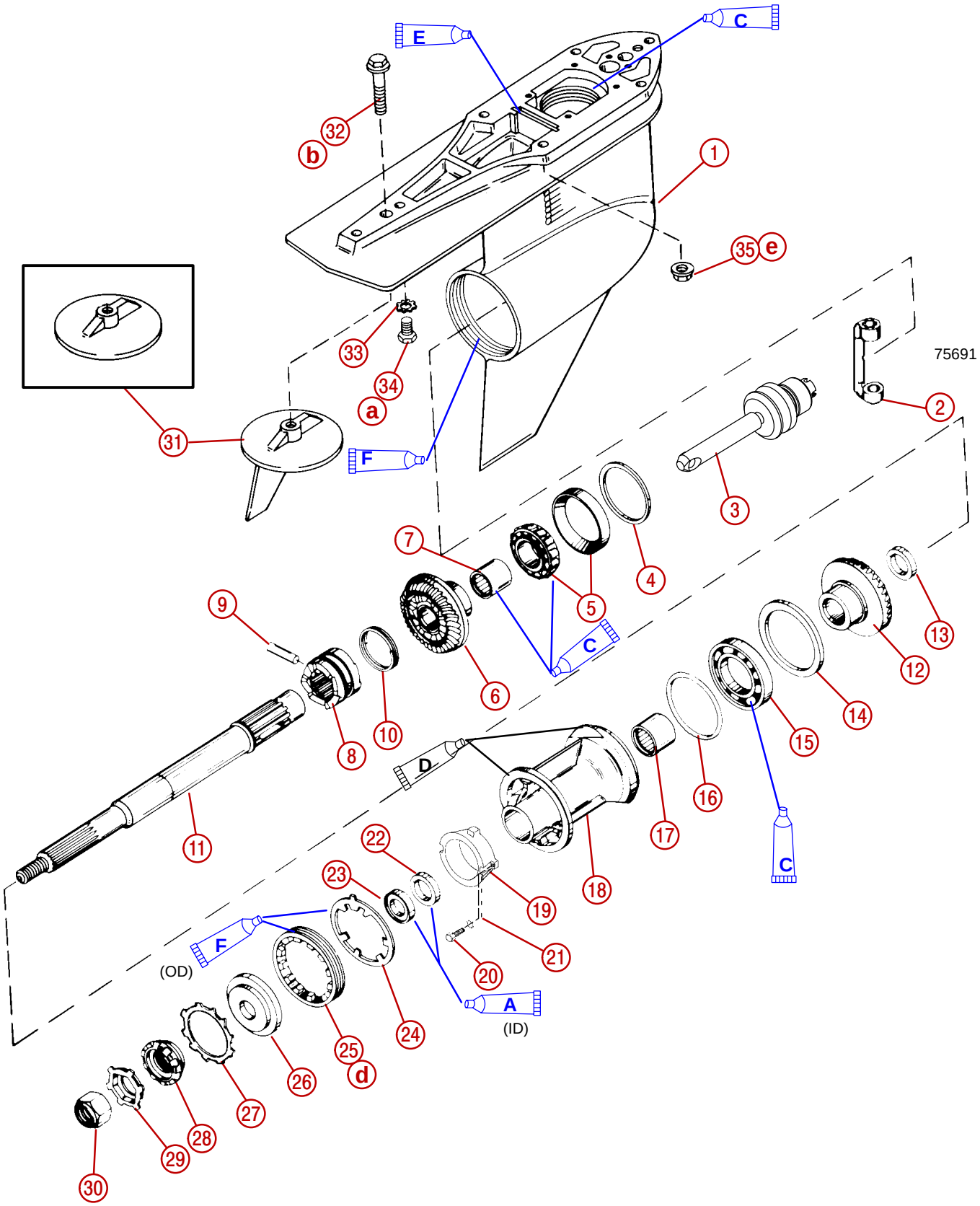
E - Quicksilver Needle Bearing Assembly Lubricant

F - Loctite 27131

Torque Specifications

a - 60 lb-in. (6.8 Nm)
b - 70 lb-ft (95 Nm)
c - 100 lb-ft (136 Nm)
d - 30-50 lb-in. (3.4-5.6 Nm)

Propeller Shaft Components



1 - Gear Housing	19 - Anode
2 - Shift Crank	20 - Screw
3 - Shift Spool Assembly	21 - Star Washer
4 - Shim, Bearing Outer Race	22 - Oil Seal (Inside)
5 - Bearing And Cup	23 - Oil Seal (Outside)
6 - Forward Gear	24 - Tab Washer
7 - Roller Bearing	25 - Retainer
8 - Sliding Clutch	26 - Thrust Hub
9 - Cross Pin	27 - Continuity Washer
10 - Spring	28 - Spline Washer
11 - Propeller Shaft	29 - Tab Washer
12 - Reverse Gear	30 - Locknut - Propeller
13 - Thrust Washer	31 - Anodic Trim Tab (Anodic Plate - Some Models)
14 - Thrust Hub	32 - Screw
15 - Ball Bearing	33 - Star Washer
16 - O-ring	34 - Screw
17 - Roller Bearing	35 - Nut
18 - Bearing Carrier Assembly	

Lubricants/Sealers/Adhesives

A - Quicksilver 2-4-C Marine Lubricant with Teflon

B - Loctite 27131

C - Quicksilver High Performance Gear Lube

D - Quicksilver Perfect Seal

E - Permatex Ultra Blue Silicone Sealant

F - Quicksilver Special Lubricant 101

Torque Specifications

a - 28 lb-ft (38 Nm)
b - 35 lb-ft (47.5 Nm)
c - 23 lb-ft (31 Nm)
d - 210 lb-ft (285 Nm)
e - 80 lb-in. (9 Nm)

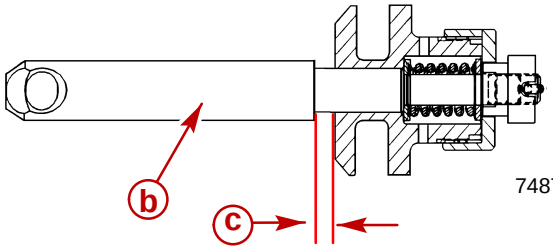
Special Information

⚠ CAUTION

Avoid damage to sterndrive unit. Drive unit damage will occur if Later Style parts are intermixed with Earlier Style parts

Shift Spool Assembly

The later style shift spool assembly has a larger gap than the earlier style. This later style shift spool beginning with serial number 0K041000 is sold as a whole assembly and can be used when replacing the earlier style (Prior to S/N 0K041000). The end play for the spool will remain the same as the earlier models (.002-.010 in. .051-.254 mm).



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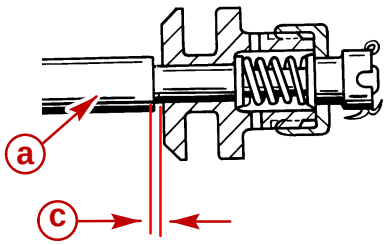
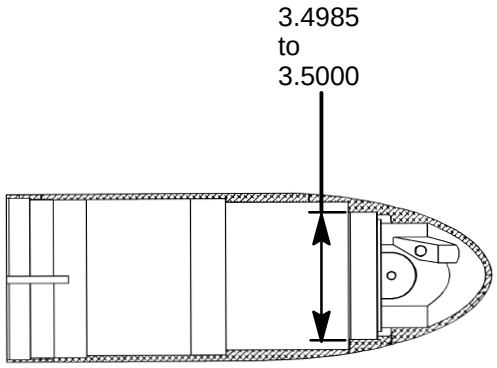


75219

a - Earlier Style Shift Spool Assembly (Prior To S/N 0K041000)
b - Later Style Shift Spool Assembly (S/N 0K041000 And Above)
c - Measure End Play Here At Gap

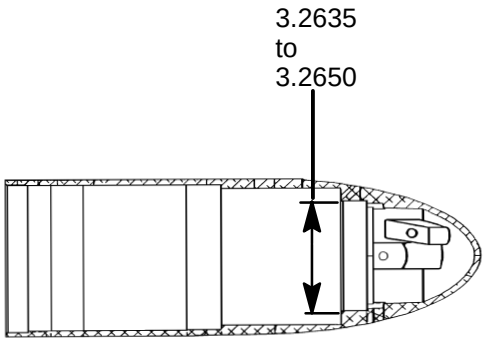
Forward Gear Bearing Bore

The later style forward gear bearing bore is smaller (3.2635 to 3.2650 in.) than the earlier style (3.4985 to 3.5000 in.) This slightly smaller bearing bore for the forward gear bearing adapter is approximately 1/4 in. (6.3 mm) smaller.



75241

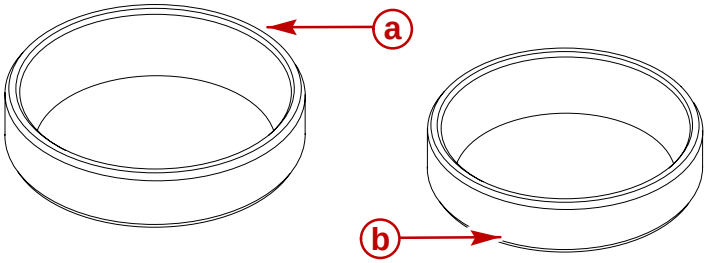
Earlier Style Forward Gear Bore (Prior to S/N OF680000)



75248

Later Style Forward Gear Bore (S/N OF680000 and Above)

The later style bearing cup is thinner and has a smaller diameter than the earlier style.



75256

a - Earlier Style Gear Bearing Cup 3.500 in. Diameter (Prior To S/N OF680000)
b - Later Style Gear Bearing Cup 3.265 in. Diameter (S/N OF680000 and Above)

Pre-Disassembly Inspection

Propeller

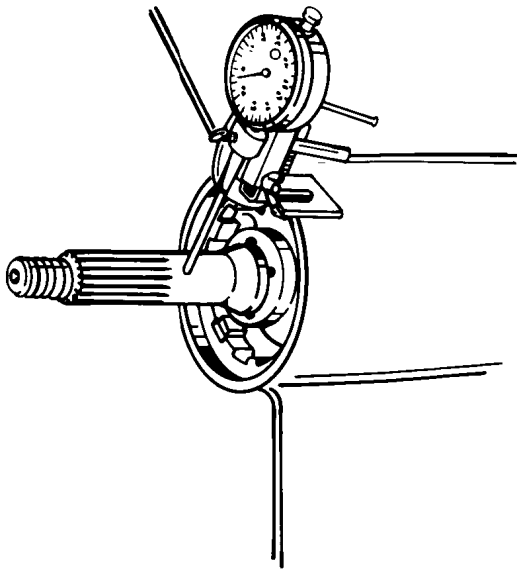
REMOVAL

1. If not already accomplished, remove the propeller and its mounting components.

Propeller Shaft

INSPECTION

1. Inspect the propeller shaft for side to side movement, as follows:
   a. Position the dial indicator on the propeller shaft.
   b. Push the propeller shaft to one side and zero the dial indicator.
   c. Move the propeller shaft to the opposite side while observing the dial indicator.A shaft deflection of more than .003 in. (0.08 mm) indicates a worn propeller shaft bearing.
2. Check for a bent propeller shaft as follows:
   a. Rotate the drive shaft in gear while observing the dial indicator. If the deflection is more than .007 in. (0.178 mm), a bent propeller shaft is indicated.

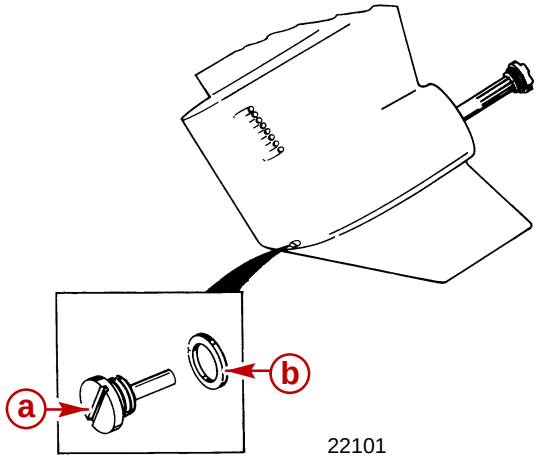


22086

Drive Shaft Housing/Gear Housing

Separation

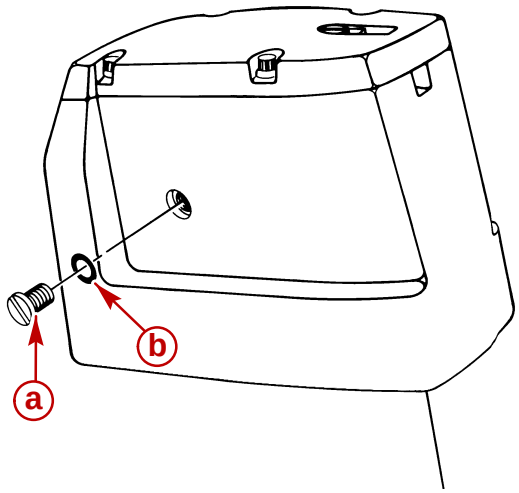
1. Clamp the unit on the gear housing anti-ventilation plate in a suitable fixture.
2. Tilt the unit at a 45 degree angle, remove the oil fill/drain plug, then remove the drive shaft housing vent screw. Allow the drive unit to drain completely.



22101

22103

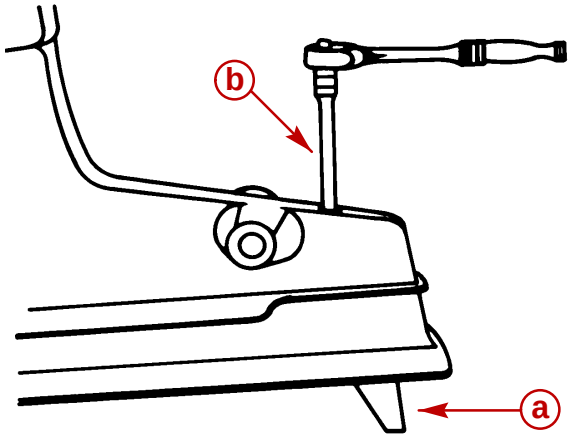
a - Fill/Drain Screw
b - Sealing Washer Or O-ring



70131

a - Vent Screw
b - Sealing Washer Or O-ring

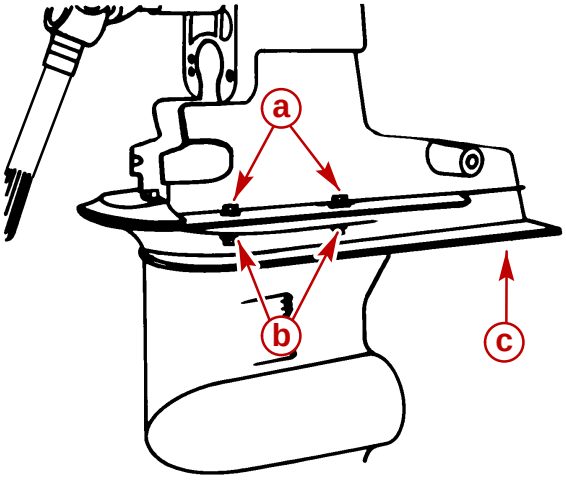
3. Mark the trim tab position (if equipped) with a piece of tape on the gear housing and remove the trim tab or anodic plate, if equipped.



70116

a - Trim Tab
b - Extension With 1/2 in. Socket

4. Remove the bolts, nuts and washers from the port and starboard sides of the unit.
5. Remove the aft screw (in the trim tab well of the gear housing).
6. Remove the nut from the forward end of the unit.



70117

a - Nuts, Bolts And Washers
b - Nut
c - Screw

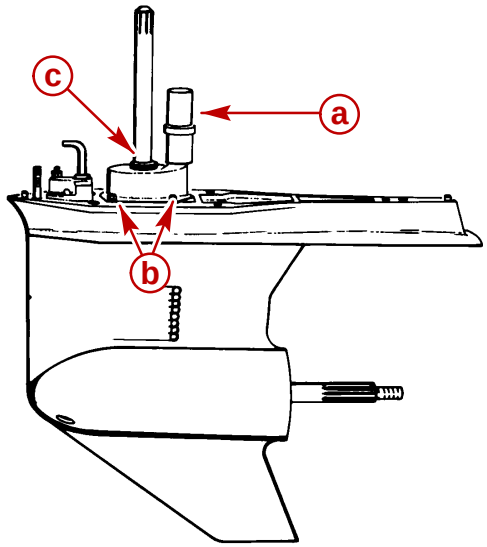
7. Lift the drive shaft housing straight off of the gear case and set aside.

Gear Housing and Component Disassembly

Water Pump Subassembly

REMOVAL

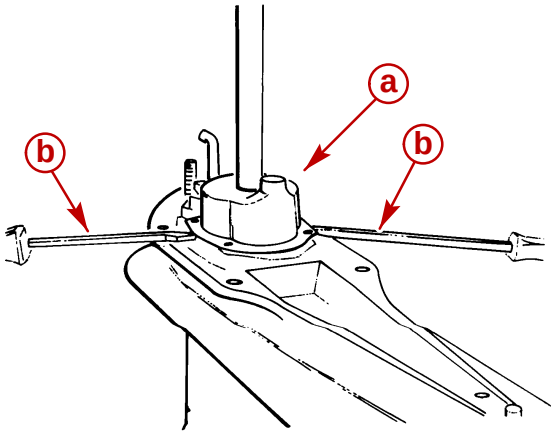
1. Remove the water seal, water tube coupling assembly and the water pump screws.



70486

a - Water Tube Assembly
b - Water Pump Screws
c - Water Seal

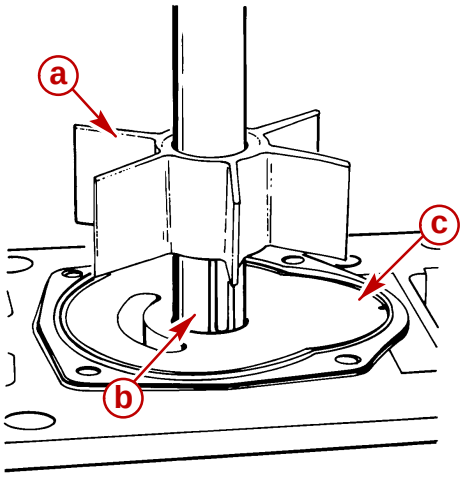
2. Carefully slide the water pump straight up off of the drive shaft. It may be necessary to gently pry up on its mounting flanges with a couple of screwdrivers.



70487

a - Water Pump Body
b - Screwdrivers

3. Remove the impeller, impeller key, the face plate and gaskets (discard the gaskets).

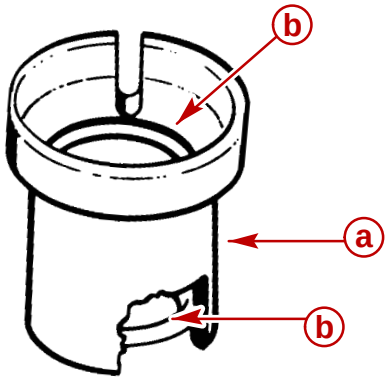


70605

a - Impeller
b - Impeller Key
c - Water Pump Face Plate and Gaskets (One On Each Side Of The Face Plate)

WATER PUMP ASSEMBLY - COMPONENT INSPECTION

1. Inspect the water tube coupling assembly for wear or damage. If necessary, replace the worn or damaged components. Check the top and bottom inside O-ring seals for wear.

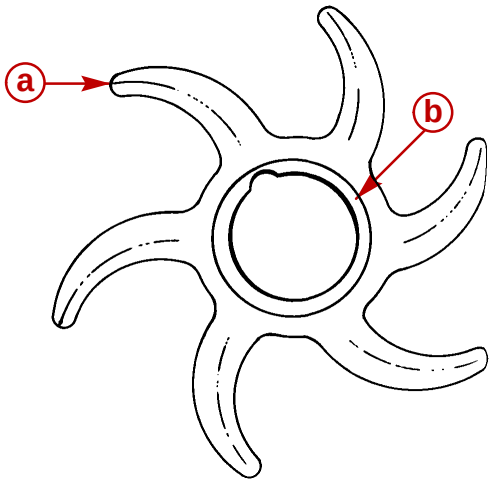


70613

a - Water Tube Adaptor
b - O-ring Seals (2)

2. Inspect the water pump impeller for wear on the end, top and bottom of the impeller blades. Replace the impeller if this condition is found.

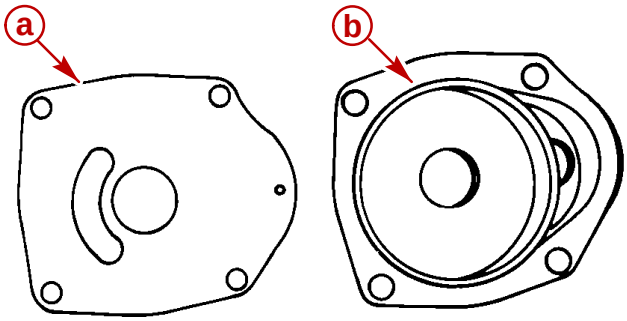
3. Inspect for proper bonding between the hub and the impeller. Replace the impeller if improper bonding is found.



70500

a - Impeller
b - Hub

4. Inspect the impeller blades to see if they are hard or deformed. Replace the impeller if the blades are in this condition.
5. Inspect the water pump face plate and the water pump interior for roughness and/or grooves. Replace the appropriate components if any are found.



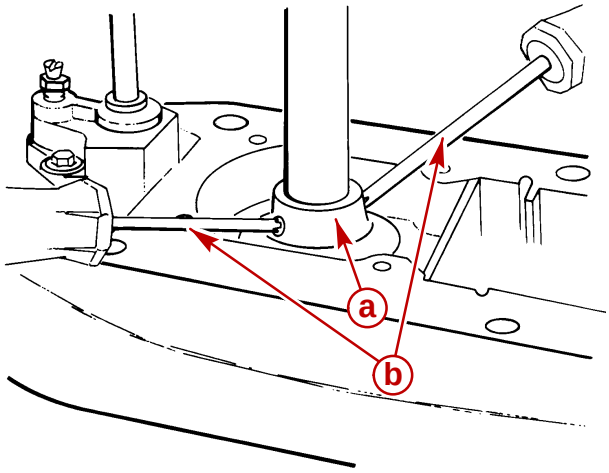
70609

a - Water Pump Face Plate
b - Water Pump Body

Oil Seal Carrier Subassembly

REMOVAL

1. Remove the oil seal carrier from the gear housing. It may be necessary to gently pry up on it with two screwdrivers.



70489

a - Oil Seal Carrier
b - Screwdrivers

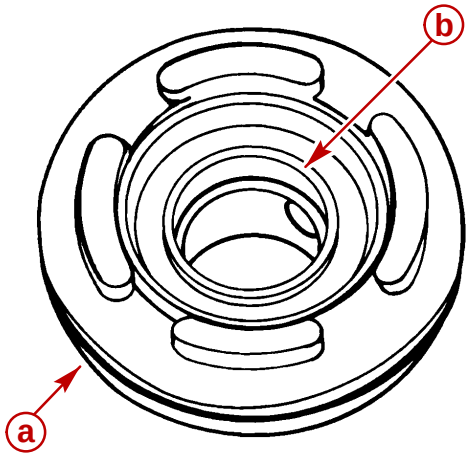
OIL SEAL CARRIER - INSPECTION

1. Inspect the oil seal carrier, O-ring and seals for wear and/or damage. If necessary, replace defective parts as follows.

OIL SEAL CARRIER - DISASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.*

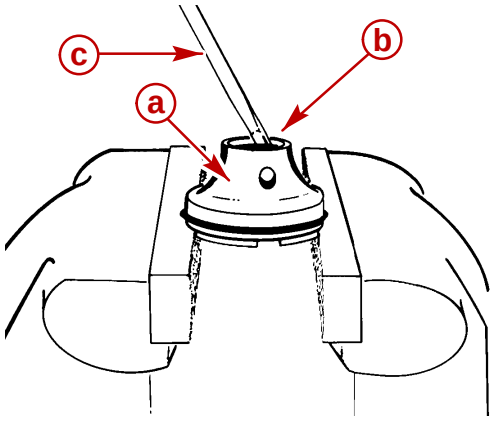
1. Remove the O-ring.



70501

a - O-ring
b - Oil Seals (2)

2. Remove the oil seals.



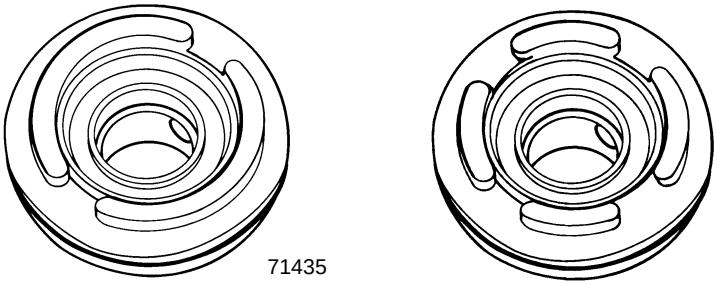
70610

a - Oil Seal Carrier
b - Oil Seals
c - Screwdriver

OIL SEAL CARRIER - REASSEMBLY

The oil seal carrier may be a brown color (aluminum) material or a black color (glass filled nylon) material. This black glass filled seal carrier will supersede the aluminum version. The new seal carrier can be identified by looking at the base. Where the old plastic carrier had only two support feet the new one will have four support feet. Also the seals in the old aluminum oil seal carrier are metal case and will require Loctite 27131 applied to the outside diameter prior to installation.

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*



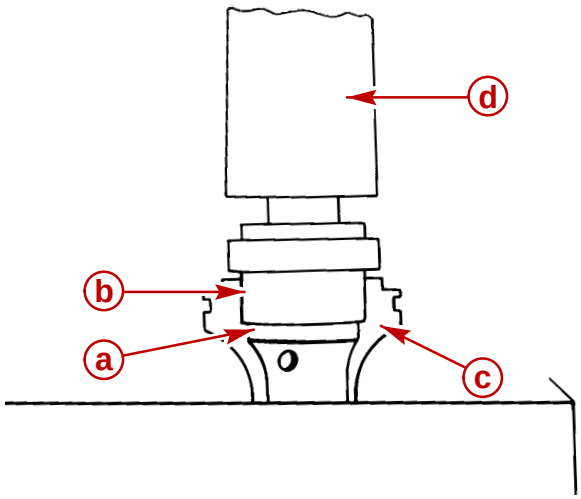
71435 70501

A. Earlier Style . . . . . B. Later Style

NOTE: *The earlier style oil seal carrier utilizes a large diameter and a small diameter oil seal. The later style uses the same oil seals as the drive shaft housing.*

1. Apply Quicksilver Perfect Seal sparingly to the oil seal bore prior to installing the oil seal into the oil seal carrier.
2. Assemble the small oil seal (with the lips of the oil seal facing away from the driver shoulder) onto the long end of the oil seal driver.

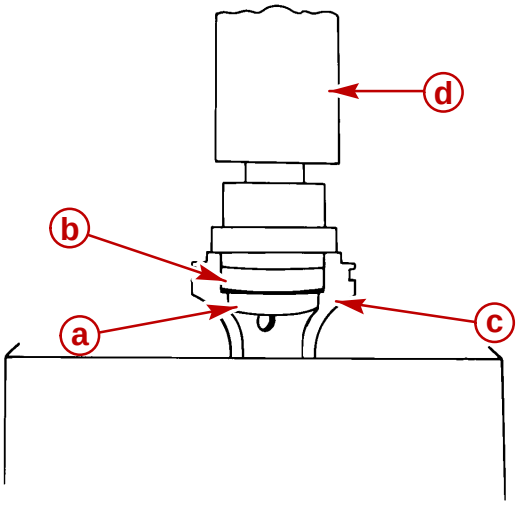
3. Press on the oil seal driver until the driver bottoms against the carrier. Do not press too hard as it could damage the oil seal carrier while driving the oil seal.



70611

a - Oil Seal
b - Oil Seal Driver (91-817569) (Use Long End)
c - Oil Seal Carrier
d - Press

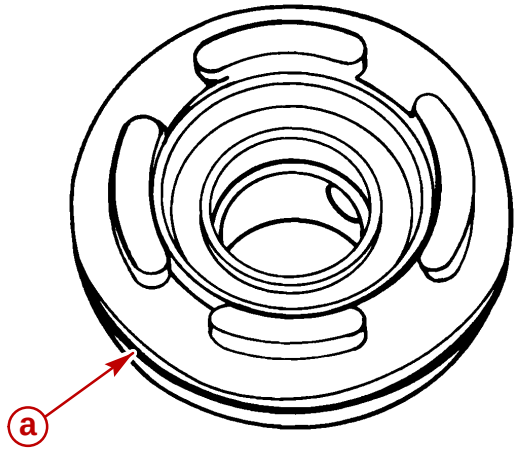
4. Apply Quicksilver Perfect Seal sparingly to the seal bore prior to installing oil seal into the oil seal carrier.
5. Assemble the large oil seal (with the lips of the oil seal facing the driver shoulder) onto the short end of the oil seal driver.
6. Press on the oil seal driver until the driver touches the carrier. Do not press too hard as it could damage the oil seal carrier while driving the oil seal.



70612

a - Oil Seal
b - Oil Seal Driver (91-817569) (Use Short End)
c - Oil Seal Carrier
d - Press

7. Install the O-ring onto the oil seal carrier.



70501

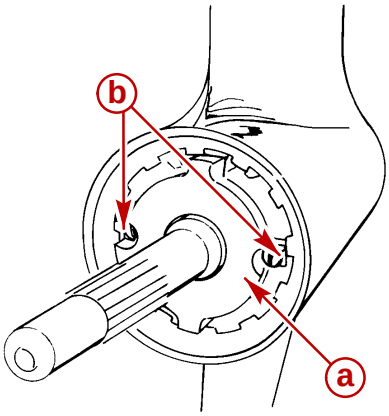
Typical

a - O-ring

Bearing Carrier Subassembly

REMOVAL

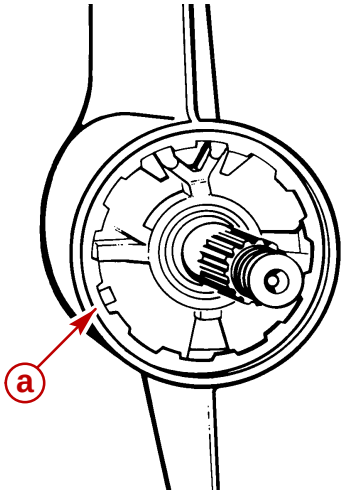
1. **If equipped**, remove anode from bearing carrier.



71958

a - Anode
b - Screws

2. Straighten the tab on the tab washer.



70490

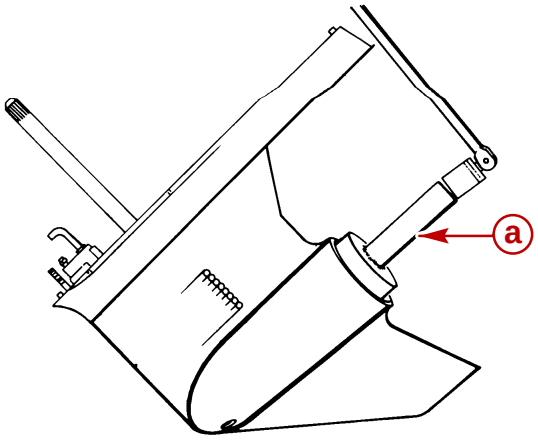
a - Tab on Tab Washer

3. Remove the bearing carrier retainer following Step “a” or “b” as necessary:

⚠ CAUTION

DO NOT drill into the gear housing retainer threads when using the following procedure for removing the retainer.

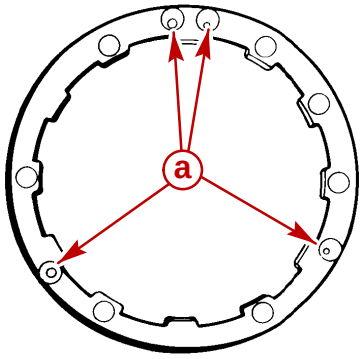
a. Remove the bearing carrier retainer using the Bearing Carrier Retainer Wrench (91-61069).



70491

a - Bearing Carrier Retainer Wrench

b. If the retainer is corroded in place, drill 4 holes in the retainer and fracture the retainer with a chisel. Pry the remaining segments out.



23356

a - Drilled Holes

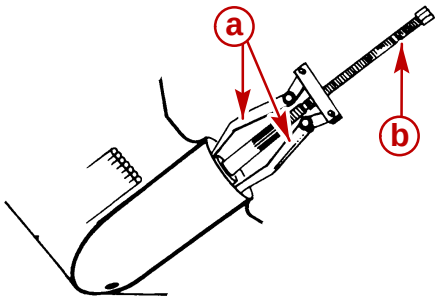
FOR EARLIER STYLE UNITS:

⚠ CAUTION

DO NOT pull on the bearing carrier outer ring, as damage to the carrier will result.

4. Pull the bearing carrier from the gear housing by the **inner bosses** located on the center area by the oil seals.

NOTE: *If the bearing carrier is seized in the gear housing, it may be necessary to use heat to loosen the carrier.*



70934

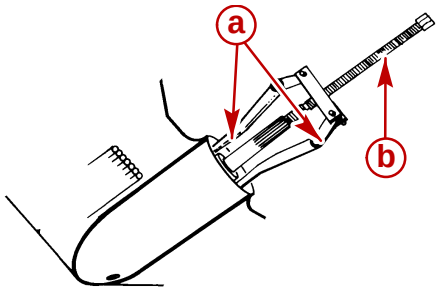
Earlier Style Units

a - Puller Jaws (91-46086 A1)
b - Puller Bolt (91-85716)

FOR LATER STYLE UNITS:

5. Pull the bearing carrier from the gear housing by pulling on the **outer ring** of the bearing carrier.

NOTE: *If the bearing carrier is seized in the gear housing, it may be necessary to use heat to loosen the carrier.*



70492

Later Style Units

a - Puller Jaws (91-46086 A1)
b - Puller Bolt (91-85716)

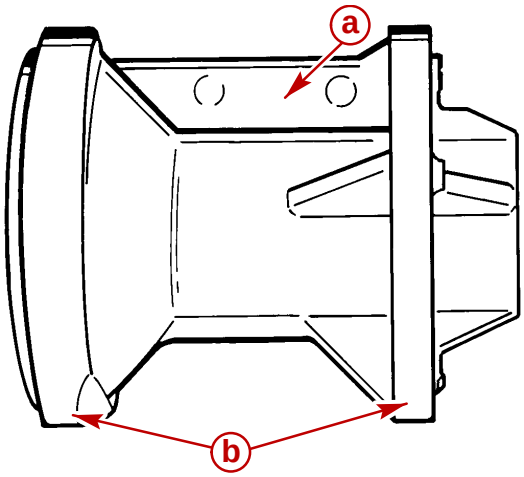
NOTE: *Puller jaws are oriented differently on the Earlier Style and the Later Style Units.*

BEARING CARRIER ASSEMBLY - INSPECTION

1. Clean the assembly with a suitable solvent and dry the parts thoroughly using compressed air.

NOTE: *If any of the following items are found to be defective complete the appropriate instruction(s) in "Bearing Carrier Assembly."*

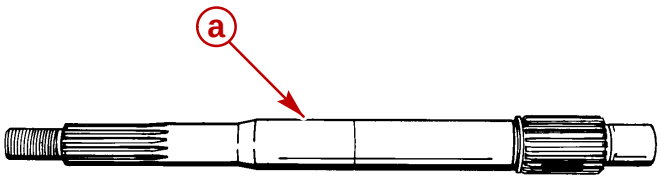
2. Inspect the bearing carrier for signs of excessive corrosion especially in the area where the bearing carrier touches the gear housing. If excessive corrosion is evident, replace the carrier.



50314

a - Bearing Carrier
b - Mating Surfaces

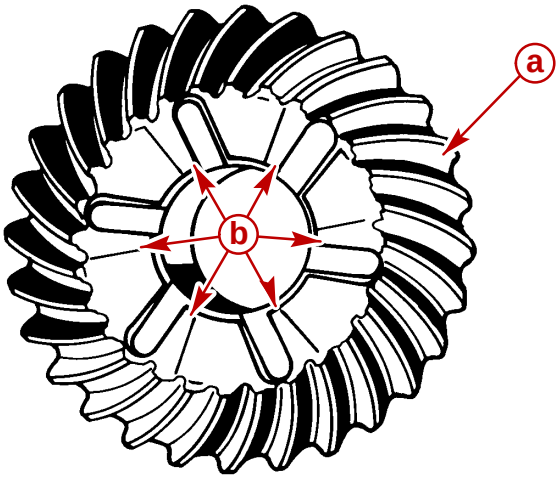
3. The condition of the bearing surface on the propeller shaft in the area that the needle bearing (in the bearing carrier) rides is an indication of the condition of the needle bearing in the bearing carrier. Replace the bearing if the surface of the shaft is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded metal particles.



23355

a - Propeller Shaft Bearing Contact Area

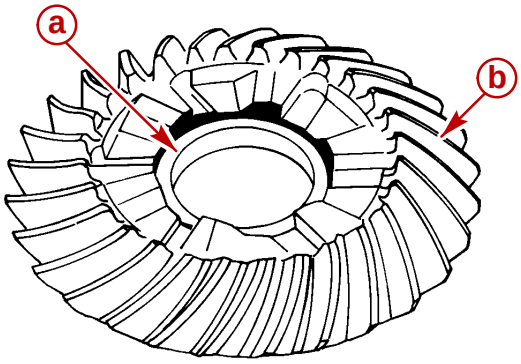
4. Inspect the reverse gear for pitted, chipped, broken teeth, hairline fractures and excessive or uneven wear. Replace the gear if any defects are found.
5. Inspect the clutch jaws of the gear for damage. Surfaces must not be chipped or rounded off. Replace the gear if any are found. Also inspect later model reverse gear and thrust spacer combination for excessive thrust spacer wear.



23355

Earlier Model Reverse Gear

a - Reverse Gear Teeth
b - Clutch Jaws

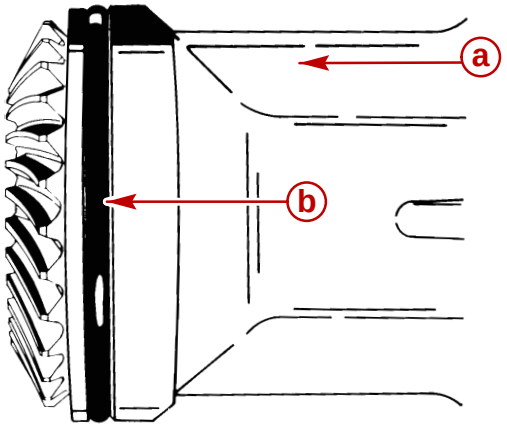


74150

Later Model Reverse Gear and Thrust Spacer

a - Thrust Washer
b - Reverse Gear

6. Inspect the reverse gear bearing for excessive movement or roughness by rotating gear. Replace the bearing if either of these conditions exists.
7. Inspect the bearing carrier retainer for cracks and/or broken or corroded threads. Replace it if any are found.
8. Remove the O-ring from the bearing carrier assembly.



23354

a - Bearing Carrier
b - O-ring

a. Inspect the O-ring for damage and or deterioration. Replace as necessary.

BEARING CARRIER ASSEMBLY - COMPONENT DISASSEMBLY AND INSPECTION

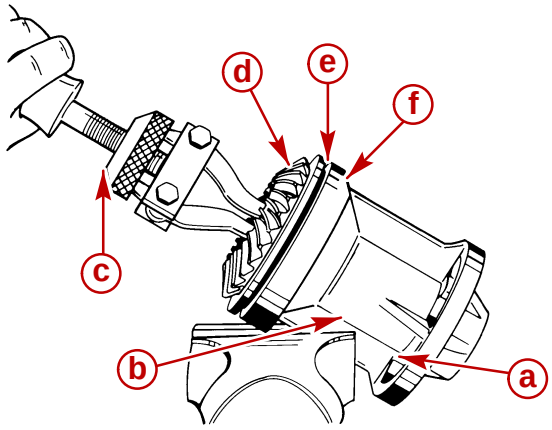
NOTE: *Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.*

⚠ CAUTION

Clamp onto the reinforcing rib of the bearing carrier ONLY, or damage to the carrier may result.

1. Remove thrust spacer from later model reverse gear (if applicable).
2. Place the bearing carrier in a vise, clamping on the reinforcing rib.

3. Remove the reverse gear, thrust ring and bearing as an assembly, using a slide hammer puller.



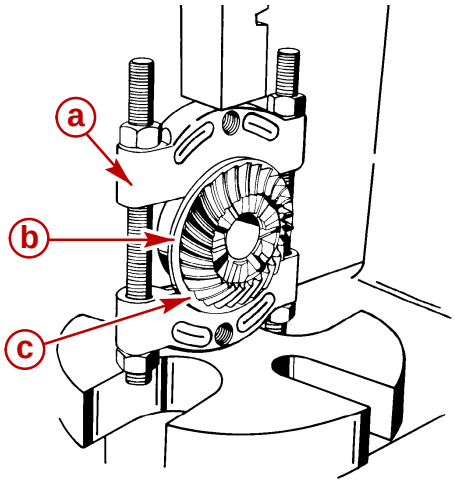
23352

a - Bearing Carrier Reinforcing Rib
b - Bearing Carrier
c - Slide Hammer Puller (91-34569 A1)
d - Reverse Gear
e - Thrust Hub
f - Bearing Located In The Carrier

4. Clean all components thoroughly with a suitable solvent and inspect them for damage and/or excessive wear. Replace any parts that are found to be defective.

IMPORTANT: The bearing MUST BE replaced if removed from gear.

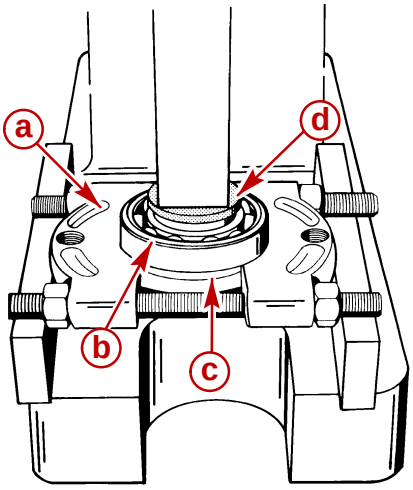
5. Place the universal puller plate between the thrust washer and bearing as shown and press on the plate until it bottoms.



23351

a - Universal Puller Plate (91-37241)
b - Thrust Washer
c - Bearing

6. Using a suitable mandrel and the universal puller plate to support the bearing, press the bearing from the reverse gear.



23351

a - Universal Puller Plate (91-37241)
b - Bearing
c - Gear
d - Suitable Mandrel

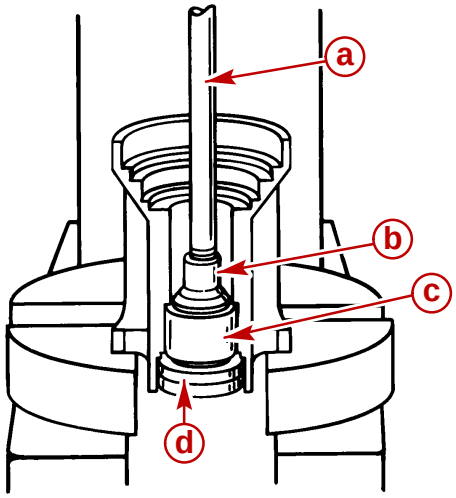
a. **Discard the bearing.**

b. Inspect the gear and thrust washer for excessive wear, cracks, or damage. Replace the appropriate components if any of these conditions are found.

NOTE: *Inspection of the bearing surfaces on the propeller shaft where the needles of the bearing carrier needle bearing rolls, gives an indication of the condition of the needle bearing inside the bearing carrier. Replace needle bearing in the bearing carrier if the prop shaft is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.*

7. Perform Step “a” or “b” as necessary.

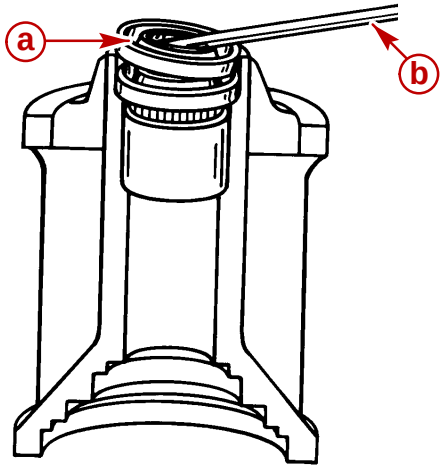
   a. **If Replacing The Needle Bearing <u>And</u> Seals:** Remove the needle bearing and seals with the tools as shown. **<u>Discard the needle bearing and both seals.</u>**



23140

a - Bearing Driver Rod (91-37323)
b - Driver Head (91-36569)
c - Needle Bearing
d - Oil Seals

   b. **If Replacing The Seal <u>Only</u>:** Remove the oil seals with a suitable pry bar, being careful not to damage the bore of the bearing carrier. **<u>Discard both of the seals.</u>**



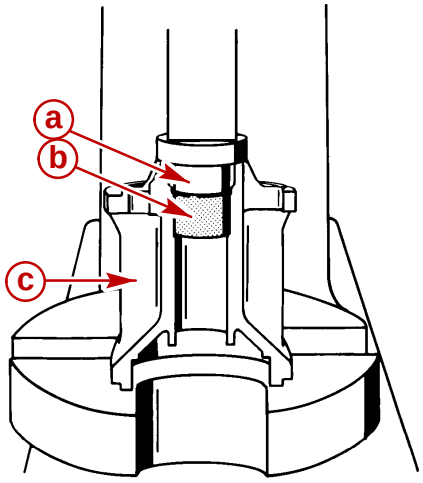
23140

a - Oil Seals
b - Pry Bar

BEARING CARRIER - REASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

1. Clean all of the components with a suitable solvent and dry the parts thoroughly using compressed air. Be careful not to spin the bearing.
2. Lubricate the bore that the needle bearing is pressed into with 2-4-C Marine Lubricant with Teflon. Make sure that none of the lubricant gets onto the seal bore. If it does, make sure that it is **thoroughly cleaned off** after the needle bearing is installed in the next step.
3. Assemble the needle bearing (with the numbered end of the bearing towards the driver shoulder), onto the driver.
4. Press the needle bearing into the bearing carrier until the driver bottoms out on the bearing carrier. Ensure that the numbered side of the needle bearing faces the seal end (aft end) of the carrier.

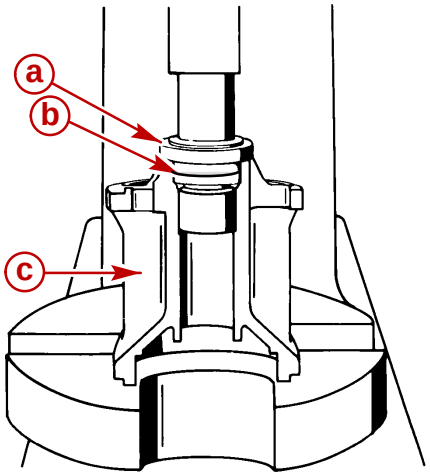


50315

a - Needle Bearing Driver (91-15755)
b - Needle Bearing
c - Bearing Carrier

5. **Thoroughly clean** the bore in which the first seal is to be pressed.
6. Assemble the first seal (with the lips of the seal facing away from the driver shoulder) onto the long end of the oil seal driver.

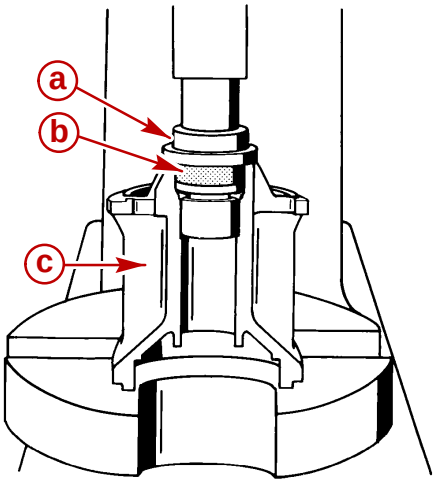
7. Press on the oil seal driver until the driver rests on the aft face of the bearing carrier.



50315

a - Oil Seal Driver (91-31108)
b - Oil Seal
c - Bearing Driver

8. Apply a thin film of Loctite 271 to the bore in which the second seal is to be pressed.
9. Assemble the second seal (with the lips of the seal facing the driver shoulder) onto the short end of the driver.
10. Press the oil seal with the driver until the driver rests on the bearing carrier.

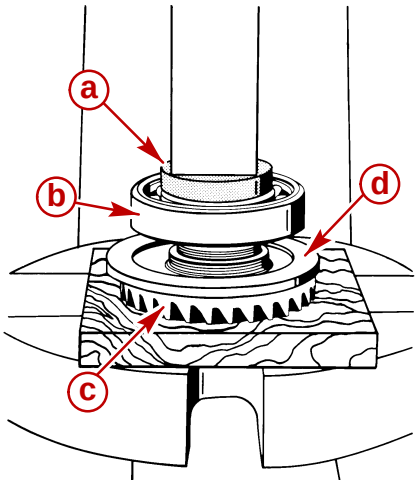


50315

a - Driver (Short End)
b - Oil Seal (Lips Toward Driver Shoulder)
c - Bearing Driver

11. Wipe up all of the excess Loctite. Do not allow any of the excess Loctite to spread to other parts of the assembly.

12. Install the thrust washer and **new ball bearing** onto the reverse gear. Press on the inner race of the ball bearing using the pilot washer until the bearing rests on the gear.

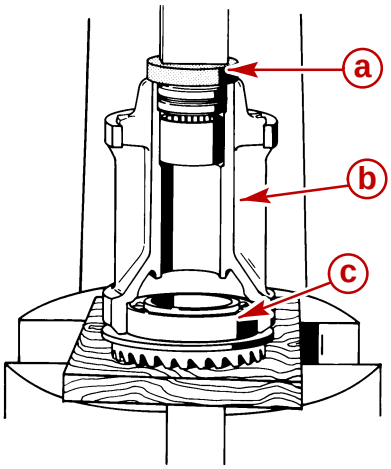


23346

a - Pilot Washer (91-36571)
b - Ball Bearing
c - Thrust Hub
d - Reverse Gear

13. Lightly lubricate the bore that the bearing is pressed into with 2-4-C Marine Lubricant with Teflon.

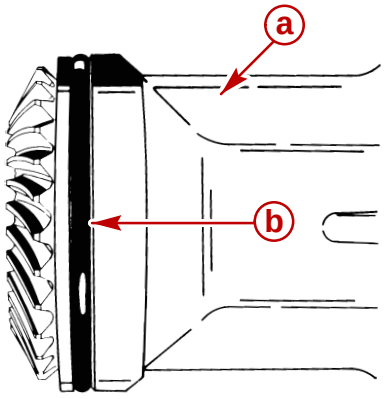
14. Press the bearing carrier onto the reverse gear and bearing until the bearing rests on the bearing carrier, using the pilot washer to press against the carrier.



23349

a - Pilot Washer (91-36571)
b - Bearing Carrier
c - Reverse Gear and Bearing Assembly

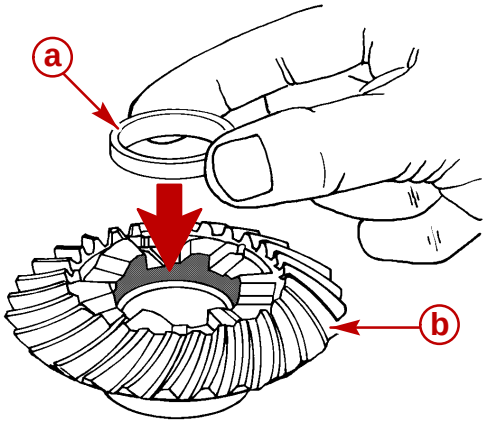
15. Install the O-ring onto the bearing carrier.



23354

a - O-ring
b - Bearing Carrier

16. If equipped with thrust spacer, install it into gear as shown.



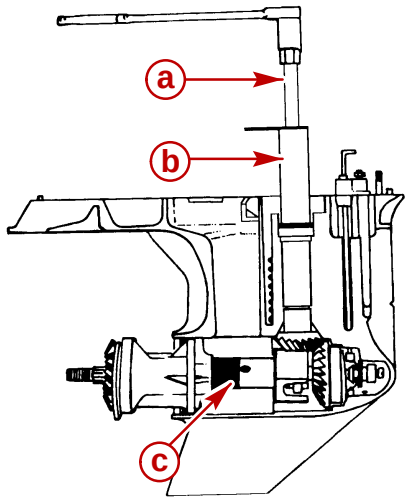
71910

a - Thrust Spacer
b - Reverse Gear

Drive Shaft Assembly

REMOVAL

1. Remove the drive shaft pinion nut as follows:
   a. Place the drive shaft nut wrench onto the drive shaft. Do not loosen the retainer at this time.
   b. Insert the pinion nut adapter with the MR slot facing the pinion gear, into the gear housing as shown. It may be necessary to slightly lift and rotate the drive shaft to align the pinion gear nut into the pinion nut adapter slot.
   c. Install the bearing carrier into the gear housing backwards to support the prop shaft and to keep the pinion nut adapter aligned.
   d. Place the drive shaft nut wrench over the drive shaft splines and **loosen**, (but do not fully unscrew) the pinion nut by rotating the drive shaft counterclockwise.

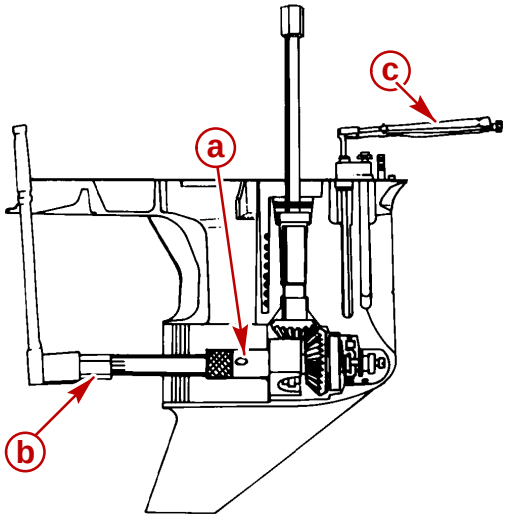


70887

a - Drive Shaft Nut Wrench (91-56775)
b - Drive Shaft Bearing Retainer Wrench (91-43506)
c - Pinion Nut Adaptor

   e. **If The Drive Shaft Is Broken,** place propeller shaft nut wrench onto the propeller shaft splines. Hold shift shaft in forward gear and **loosen** but do not fully unscrew the pinion nut by rotating prop shaft counterclockwise to turn gears.

NOTE: *The propeller shaft nut wrench is included with the pinion nut adapter kit.*



70607

a - Pinion Nut Adaptor (91-61067 A3)
b - Propeller Shaft Nut Wrench (91-61077)
c - Shift Shaft (Turn Clockwise)

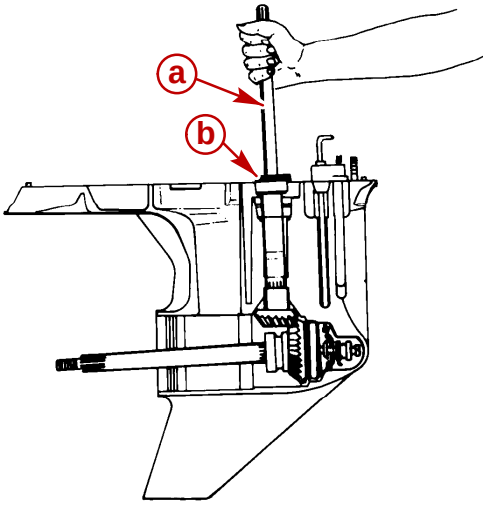
f. Completely unscrew the drive shaft bearing retainer.

g. Completely unscrew the pinion nut by rotating the drive shaft (or the propeller shaft) in a counterclockwise direction.

h. Remove all tools.

IMPORTANT: The pinion bearing rollers are free to fall out of the pinion bearing once the drive shaft is removed. Be careful not to lose the (18) rollers.

2. Remove the drive shaft and all components by pulling the drive shaft straight out of the gear housing as shown.



70608

a - Drive Shaft
b - Drive Shaft Retainer, Bearing Cup, Bearing and Shims

3. Retrieve the pinion gear, the washer and the nut from the inside of the gear housing.

DRIVE SHAFT ASSEMBLY - INSPECTION

1. Clean all parts with a suitable solvent and dry the parts thoroughly using compressed air. Be careful not to spin the bearings.
2. The condition of the drive shaft bearing cup is an indication of the condition of the tapered roller bearing on the drive shaft. Replace the bearing and bearing cup if the cup is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.
3. Inspect the bearing surface on the drive shaft where the needles of the lower pinion bearing roll. Replace the drive shaft if it is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.
4. Inspect the splines at both ends of the drive shaft for a worn or twisted condition. Replace the drive shaft if either condition exists.
5. Inspect the gear for pitting, chipped or broken teeth, hairline fractures and excessive or uneven wear. **Replace the pinion gear and the forward gear** if any defects are found.

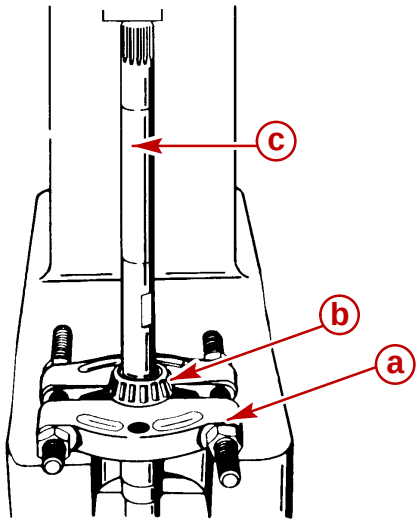
DRIVE SHAFT - DISASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.*

⚠ CAUTION

Ensure that the universal puller plate does not contact with the sides of the drive shaft.

1. Press the tapered roller bearing from the drive shaft using the universal puller plate to support the **inner race** of the bearing while removing it.



70699

a - Universal Puller Plate (91-37241)
b - Tapered Roller Bearing
c - Drive Shaft

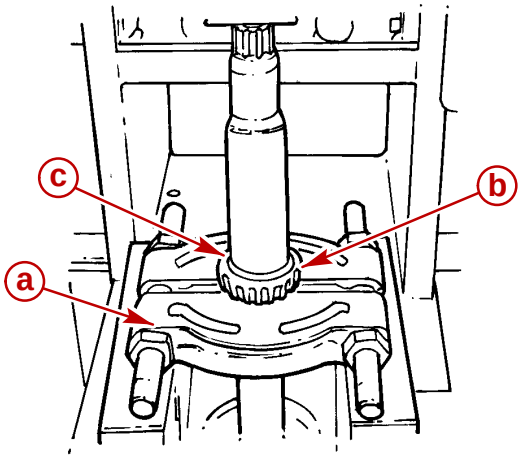
DRIVE SHAFT - REASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

⚠ CAUTION

Ensure that the universal puller plate does not make contact with the sides of the drive shaft.

1. Assemble a new tapered roller bearing on the drive shaft with the large O.D. of the bearing facing the pinion gear end of the drive shaft.
2. Press the tapered roller bearing onto the drive shaft using the universal puller plate and a suitable mandrel (an old tapered roller bearing inner race).



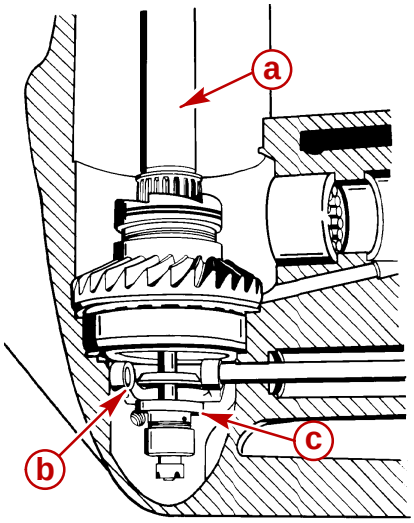
77707

a - Universal Puller Plate (91-37241)
b - Tapered Roller Bearing
c - Suitable Mandrel

Propeller Shaft Assembly and Forward Gear Bearing Cup

REMOVAL

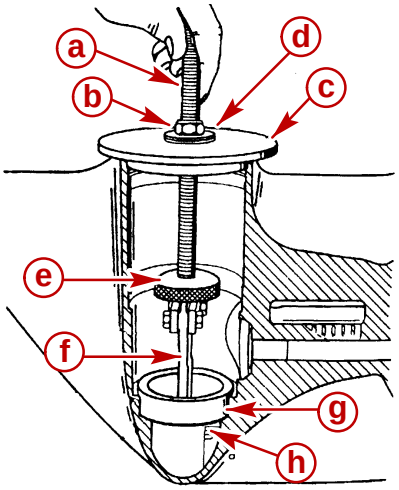
1. Tilt the propeller shaft to the port side of the gear housing and remove the shaft by pulling it up and out.



23348

a - Propeller Shaft Assembly
b - Shift Spool
c - Shift Crank

2. Remove the forward gear bearing cup and shims. Measure and make note of the shim thickness and **discard (do not reuse) the shims.**



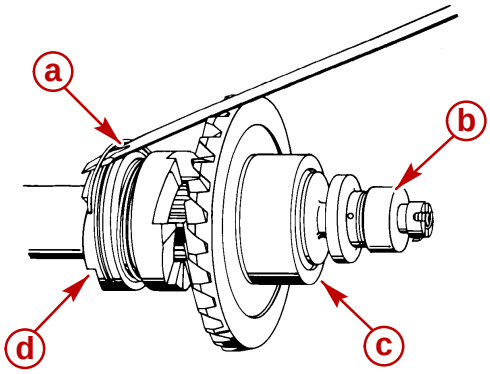
74008

a - Puller Shaft (91-31229)
b - Nut (11-24156)
c - Guide Plate (91-816243)
d - Washer (91-34961)
e - Puller Head (From Slide Hammer Puller 91-34589A1)
f - Jaws (From Slide Hammer Puller 91-34589A1)
g - Bearing Adaptor
h - Shims

PROPELLER SHAFT DISASSEMBLY

NOTE: *When accomplishing the next step, all of the parts are free to come apart. Work closely over a work bench to ensure that the parts are not dropped or damaged and to avoid personal injury.*

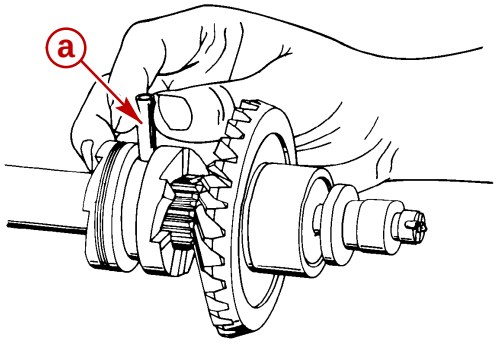
1. Remove the spring around the clutch being careful not to over-stretch it during removal. If the spring does not coil back to its normal position once it has been removed, it must be replaced.



50885

a - Spring
b - Shift Spool Assembly
c - Reverse Gear Assembly
d - Sliding Clutch

2. Remove the cross pin that goes through the clutch.



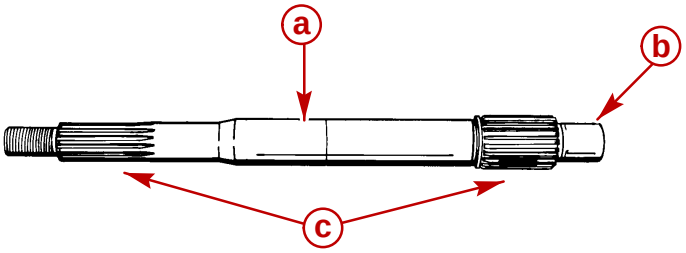
50885

a - Cross Pin

3. Remove the remainder of the components.

PROPELLER SHAFT INSPECTION

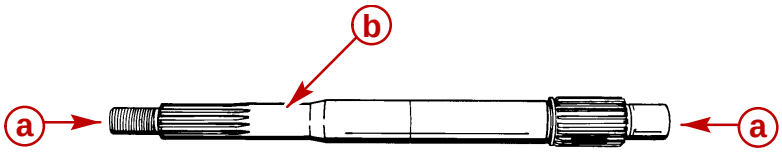
1. Clean all the parts with a suitable solvent and dry the parts thoroughly using compressed air, being careful not to spin bearings.
2. Inspect the sliding clutch jaws for damage. Jaws must not be chipped or rounded off. Replace the clutch if they are.
3. Inspect the bearing surfaces on the propeller shaft where the needles of the bearing carrier needle bearing and the needles of the forward gear needle bearing roll. Replace the propeller shaft if it is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles.



23355

a - Bearing Carrier Needle Bearing Contact Area
b - Forward Gear Needle Bearing Contact Area
c - Splines

4. Inspect the propeller shaft splines at both ends for a broken, worn, or twisted condition. Replace the propeller shaft if any of these conditions exists.
5. Inspect the surface of the propeller shaft where the bearing carrier seal lips contact the shaft. If the oil seals have made grooves, the propeller shaft must be replaced.
6. Inspect the propeller shaft for a bent condition. Use either one of the following methods.
   a. **Method 1 - V-Blocks and Dial Indicator**
      (1.) Position the propeller shaft bearing surfaces on V-blocks.
      (2.) Adjust the height of V-blocks to level the propeller shaft.
      (3.) Position the dial indicator tip just forward of the propeller shaft splines.
   b. **Method 2 - Lathe and Dial Indicator**
      (1.) Mount the propeller shaft between the centers of a lathe or other appropriate device.
      (2.) Position the dial indicator tip just forward of the propeller shaft splines.



23355

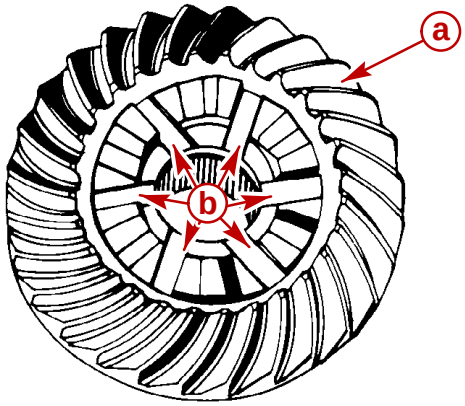
a - Propeller Shaft Centers
b - Check Movement With Dial Indicator (91-58222 A1)

7. Rotate the propeller shaft and observe the dial indicator movement, If the indicator in the dial moves more than .007 in. (0.178 mm), replace the propeller shaft.

Forward Gear Assembly

INSPECTION

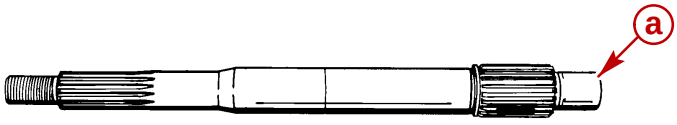
1. Clean the forward gear assembly and the forward gear bearing cup, thoroughly with a suitable solvent and dry thoroughly with compressed air. Be careful not to spin the bearings.
2. Inspect the gear for pitting, chipped or broken teeth, hairline fractures and excessive or uneven wear. **Replace the forward gear and the pinion gear** if any defects are found.
3. Inspect the clutch jaws of the gear for damage. The surfaces must not be chipped or rounded off. **Replace both the forward and pinion gear** if any of these conditions exist.



23351

a - Forward Gear Teeth
b - Clutch Jaws

4. Inspect the needle bearings on the inside of the forward gear and the bearing surface on the propeller shaft. If either the needle bearing or the bearing surface of the propeller shaft is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles, replace the propeller shaft and remove and replace the needle bearing in the forward gear as outlined in the next section.



23355

a - Forward Gear Needle Bearing Contact Area

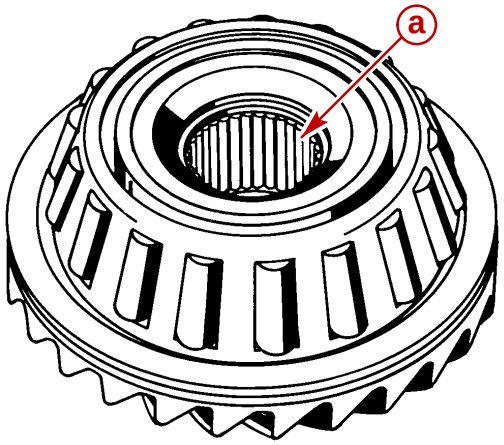
5. Inspect the tapered roller bearings on the forward gear and the bearing surface on the forward gear bearing cup. If either the roller bearings or the bearing surface of the forward gear bearing cup is pitted, grooved, scored, worn unevenly, discolored from overheating, or has embedded particles, replace the forward gear bearing cup and remove and replace the tapered roller bearings as outlined in the next section.

FORWARD GEAR DISASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.*

NOTE: *The forward gear needle bearing case is made of a very high tensile steel. Removal of the bearing by conventional methods (e.g. - chisel and hammer or mandrel and press) may be very difficult. A notch in the casing may be made with the use of a high speed grinder.*

1. Remove the forward gear needle bearing.



23352

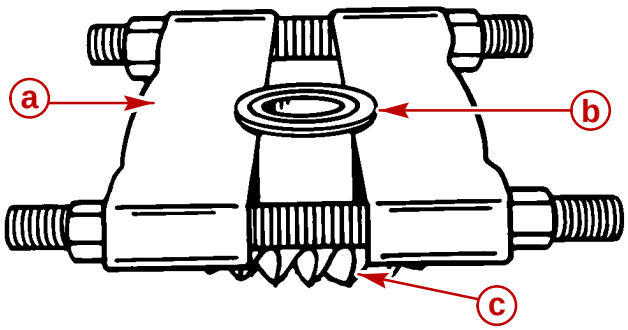
a - Forward Gear Needle Bearing

2. If it has been determined by previous inspection that the forward gear or tapered roller bearing needs to be replaced, remove the tapered roller bearing from the forward gear as follows:

   a. Cut off the roller bearing cage and remove rollers.

NOTE: *It may be necessary to grind a groove at the top lip of the bearing race to provide a lip for the universal puller plate.*

   b. Press the gear from the bearing race, using a suitable mandrel.



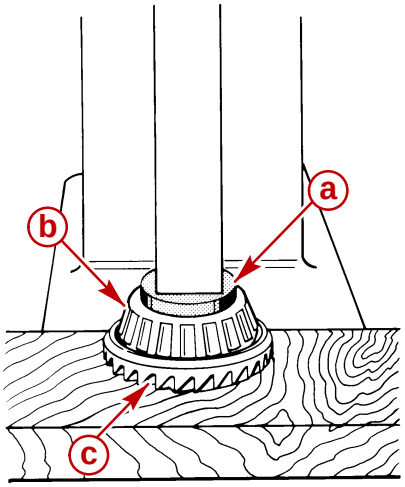
23141

a - Universal Puller Plate (91-37241)
b - Inner Bearing Race
c - Forward Gear

FORWARD GEAR REASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

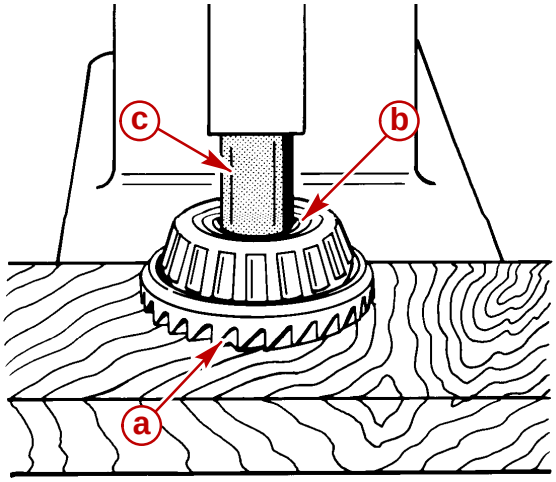
1. Using a suitable mandrel, press the tapered roller bearing onto the forward gear by pressing on the inner bearing race, until the bearing bottoms out on the gear.



23353

a - Forward Gear
b - Tapered Roller Bearing
c - Suitable Mandrel

2. Using the needle bearing driver press the needle bearing, with the the lettered side facing away from the gear teeth, into the forward gear until the bearing bottoms inside the gear.



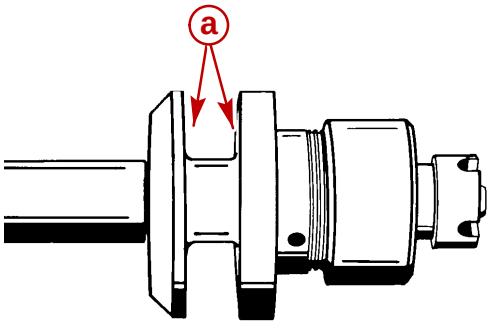
23350

a - Forward Gear
b - Needle Bearing
c - Needle Bearing Driver (91-33491)

Shift Spool Assembly

INSPECTION

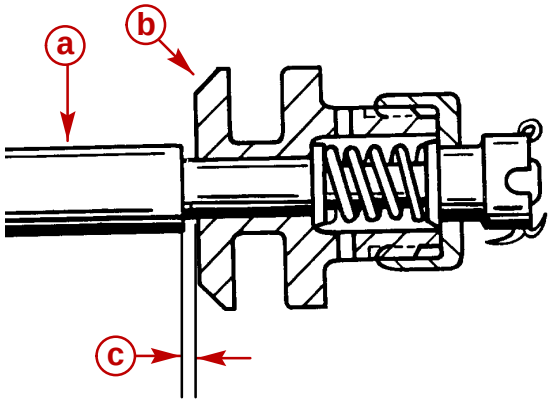
1. Clean the assembly with a suitable solvent and dry the parts thoroughly using compressed air.
2. Inspect the shift spool assembly for damage. Small nicks and burrs may be smoothed. If any parts are damaged or worn beyond repair it will be necessary to replace the complete shift spool assembly. Individual parts are not available for the assembly.
3. Inspect the shift spool for wear in the area where the shift crank comes into contact.



23356

a - Contact Area

4. Ensure that the spool spins freely. It may be helpful to lightly tap the castle nut end of the shift shaft against a firm surface to align the internal parts.
5. Ensure that the spool has 0.002-0.010 (0.051-0.254 mm) end play.
6. To check end play:
   a. Push in on the shift spool. Take measurement.
   b. Pull out on the shift spool. Take measurement.
   c. The difference between the two measurements is the end play.

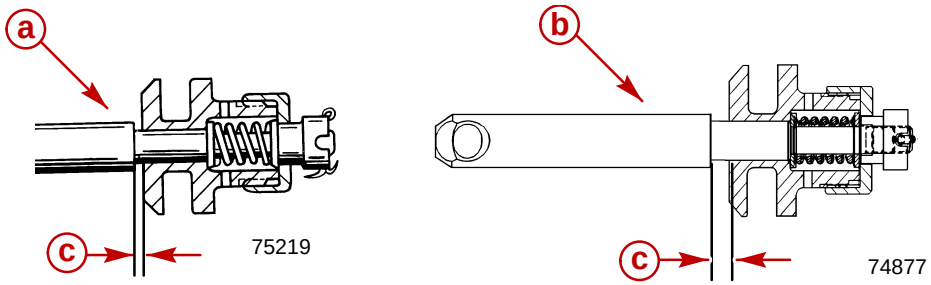


74877

a - Shift Shaft
b - Spool
c - Gap

NOTE: *The later style shift spool assembly has a larger gap than the earlier style. This later style shift spool beginning with serial number 0K041000 is sold as a whole assembly and*

can be used when replacing the earlier style (Prior to S/N 0K041000). The end play for the spool will remain the same as the earlier models .002-.010 in. (.051-.254 mm).



a - Earlier Style Shift Spool Assembly (Prior To S/N 0k041000)
b - Later Style Shift Spool Assembly (S/N 0k041000 And Above)
c - Measure End Play Here At Gap

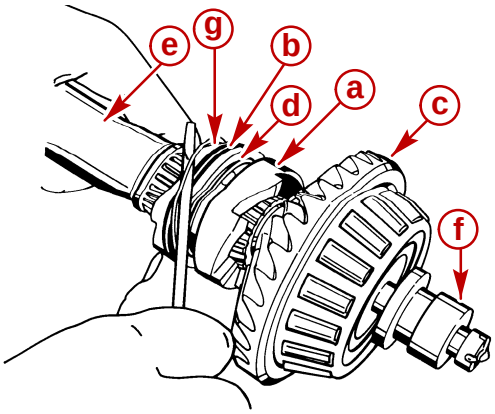
Propeller Shaft Assembly

REASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

1. Assemble the sliding clutch on the propeller shaft, being sure to align cross pin holes in the clutch with the slot in the propeller shaft. Make sure that the sliding clutch is placed on the propeller shaft with the grooved end of the clutch facing the propeller end of the shaft.
2. Assemble the forward gear assembly to the propeller shaft.
3. Assemble the shift spool assembly to the propeller shaft being sure to align the cross pin hole of the shift spool shaft with the clutch.
4. Assemble the cross pin through the sliding clutch, through the propeller shaft and through the shift spool shaft hole.
5. Assemble the cross pin retaining spring over the propeller end of the propeller shaft and wind it around the clutch over the cross pin hole. Be careful not to distort the spring while assembling it.

IMPORTANT: Make sure that the spring is wound on so that it does not cross over on itself and that it lies flat against the clutch once it is assembled. If it does not lie flat against the clutch, a new spring must be installed.



23350

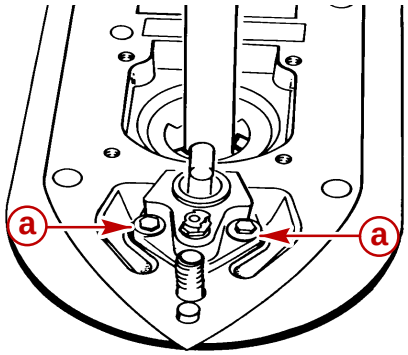
a - Sliding Clutch
b - Grooves in Clutch
c - Forward Gear Assembly
d - Cross Pin
e - Propeller Shaft
f - Spool and Actuating Shaft Assembly
g - Cross Pin Retaining Spring

Shift Shaft Assembly

REMOVAL

NOTE: *It is possible to remove and service the shift shaft assembly (but not the shift crank inside the gear case) without removing any of the internal components of the gear housing.*

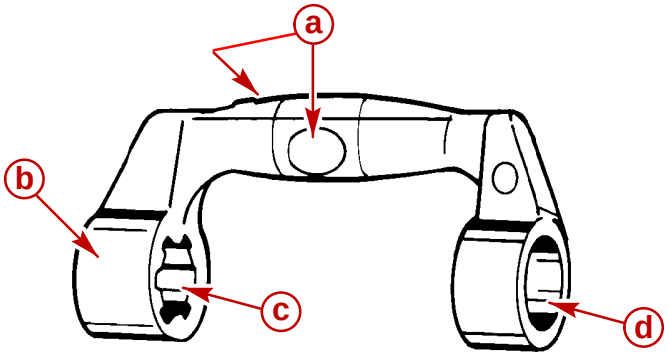
1. Remove the shift shaft bushing screws and remove the shift shaft by pulling it straight out of gear housing.



70494

a - Shift Shaft Bushing Screws

2. Remove the shift crank from the inside of the gear housing. Clean it with a suitable solvent and dry it thoroughly. Inspect it for wear in the areas that contact the shift spool and inspect the splines and the diameter that goes over the locating pin for damage or excessive wear.

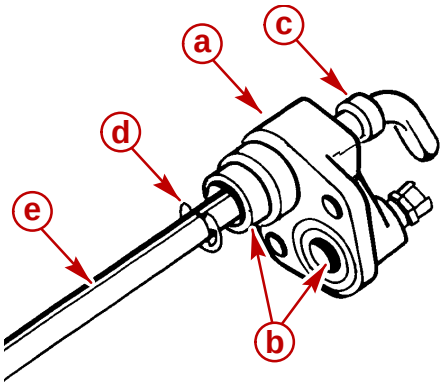


23350

a - Contact Area
b - Shift Crank
c - Splines
d - Diameter for Locating Pin

DISASSEMBLY AND INSPECTION

1. Remove the clip and slide the bushing assembly off of the straight end of the shift shaft. Remove the sleeve from the shaft.

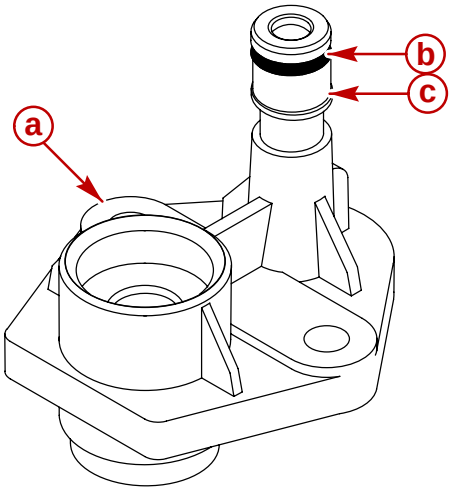


70616

a - Shift Shaft Bushing
b - O-rings (2)
c - Sleeve
d - Clip
e - Shift Shaft

2. Clean all components with a suitable solvent and dry thoroughly with compressed air.
   a. Inspect the shift shaft bushing for cracking, damage, or excessive wear.
   b. Inspect the seal inside the bushing, the sleeve and the O-ring for damage or excessive wear.
   c. Inspect the speedometer connector for damage or blockage.

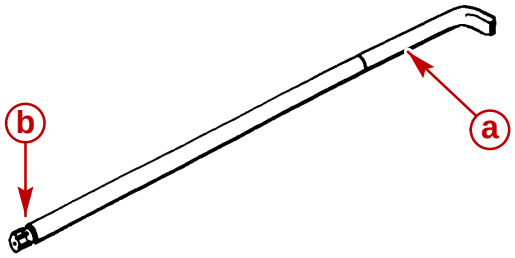
If any of these conditions exist, replace the appropriate components. Note that the bushing and seal are available only as an assembly.



75670

a - Shift Shaft Bushing
b - O-ring
c - Speedometer Tube Connector

3. Inspect the shift shaft splines and seal surface for corrosion, bent condition and/or excessive wear. Replace the shift shaft if either if these conditions are found.



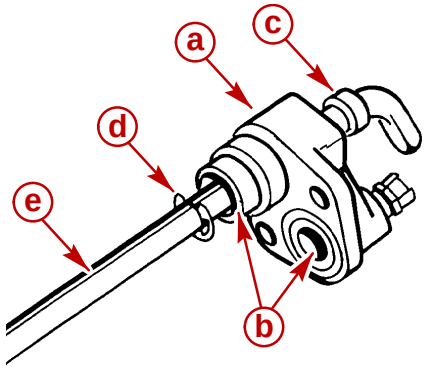
70618

a - Seal Surface
b - Spline

REASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

1. Lightly lubricate the seats of the O-ring diameters on the bushing and the lip of the oil seal with Quicksilver 2-4-C Marine Lubricant with Teflon.
2. If the speedometer connector was removed and/or replaced, lightly coat the **threads of the connector** with Quicksilver Perfect Seal. Assemble the speedometer connector to the bushing and torque the connector to 4.5 lb-in. (0.51 Nm).
3. Assemble all components.



70616

a - Shift Shaft Bushing
b - O-rings (2)
c - Sleeve
d - Clip
e - Shift Shaft

NOTE: *For reinstalling the shift shaft when none of the other components of the gear housing were disassembled see the "Shift Shaft Assembly," "Installation."*

Pinion Bearing

REMOVAL

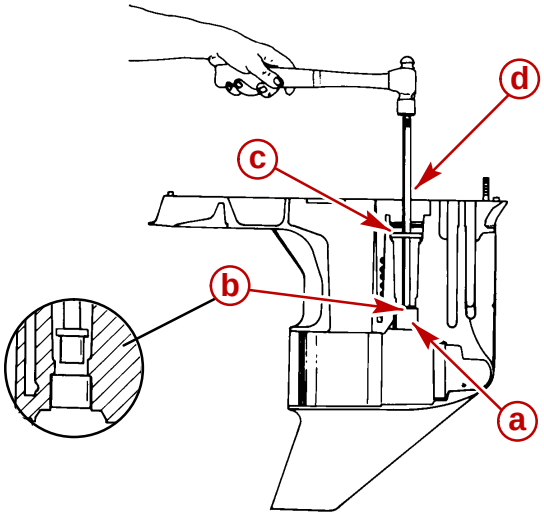
NOTE: *Inspect the bearing surface on the drive shaft where the needles of the lower pinion bearing roll. The condition of the drive shaft at this location give an indication of the condition of the needle bearing. Replace lower pinion bearing (needles and race as a set) if the drive shaft is pitted, grooved scored, worn unevenly, discolored from overheating, or has embedded particles.*

IMPORTANT: All the needle bearings (18) MUST BE in place inside bearing race while driving the pinion bearing from the gear housing.

IMPORTANT: Do not reuse the bearing (race or rollers) once it has been removed.

1. Remove and discard the pinion bearing (race and rollers) using tools as shown.

NOTE: *Hold down on the driver rod.*



70614

a - Pinion Bearing
b - Bearing Driver (91-36569)
c - Pilot Washer (91-36571)
d - Driver Rod (91-37323)

Gear Housing Reassembly

Gear Housing Inspection

1. Clean the gear housing thoroughly with a suitable solvent and a hard bristle brush. Dry the gear housing thoroughly using compressed air. Ensure that all sealants, locking agents and debris are removed.
2. Inspect the gear housing for excessive corrosion, impact or any other damage. Excessive damage and/or corrosion requires replacement of the gear housing.
3. Inspect the bearing carrier retainer threads in the gear housing for corrosion and/or stripped threads. Excessive damage to the threads requires replacement of the gear housing.
4. Inspect bearing race/cup contact areas for evidence of bearing cup spinning. Check that bearing cups are not loose in bearing bores. Any one bearing bore in which the race/cup is loose may require replacement of the gear housing.
5. Inspect for blockage in water inlet holes and the speedometer hole, clean as necessary. Be careful not to enlarge the speedometer hole as this could cause erroneous speedometer readings.
6. Make sure that the locating pins are in place in the gear housing and that the corresponding holes in the drive shaft housing are not elongated. The drive shaft may break if the housings are not aligned properly due to missing locating pins or elongated holes.

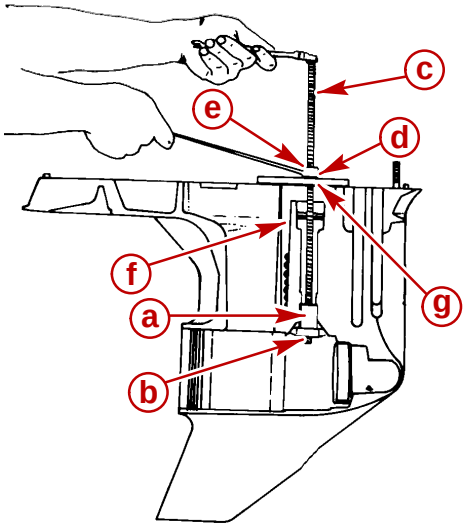
Pinion Bearing

INSTALLATION

IMPORTANT: Install only a NEW pinion bearing (race and rollers). Do not reinstall a pinion bearing that has been previously removed from a gear housing.

1. Lubricate the bore into which the pinion bearing is to be installed with Quicksilver High Performance Gear Lube.
2. Position the new pinion bearing (with the cardboard shipping sleeve in place) onto the driver head, with the lettered and numbered side of the bearing oriented upward.

3. Insert the driver with the bearing assembly, into position (by way of the propeller shaft bore) at the drive shaft bore as shown.



70615

a - Drive Shaft Pinion Bearing
b - Driver Head (91-38628)
c - Puller Shaft (91-31229)
d - Washer (12-34961)
e - Nut (11-24156)
f - Pilot Washer (91-36571)
g - Puller Plate (91-29310)

4. Install the bearing by screwing down the nut until the bearing is fully seated against the bore shoulder.

Forward Gear Bearing Cup

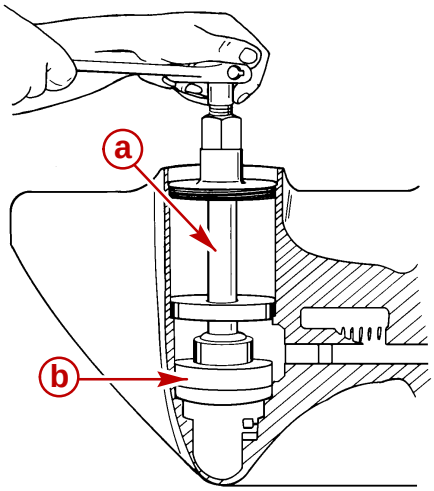
INSTALLATION

NOTE: *If the forward gear, forward gear bearing and cup, or gear housing were not replaced, install the same quantity of shims, (but not the same shims), that were taken out when cup was removed. If the forward gear, forward gear bearing/cup, or gear housing were replaced, install approximately .020 in. (0.51 mm) of shims as a starting point.*

NOTE: *If backlash has already been checked and you have determined that it needs to be adjusted, see Checking Forward Gear Backlash on page 3B-39. Adding .001 in. (0.025 mm) shims will* ***reduce*** *the gear backlash by approximately the same amount.*

1. Lubricate the bore into which the forward gear bearing cup is to be installed with Quicksilver High Performance Gear Lube.
2. Place the shim(s) into forward bore of gear housing.

3. Install the bearing cup and forward gear shims using the special tools as shown.



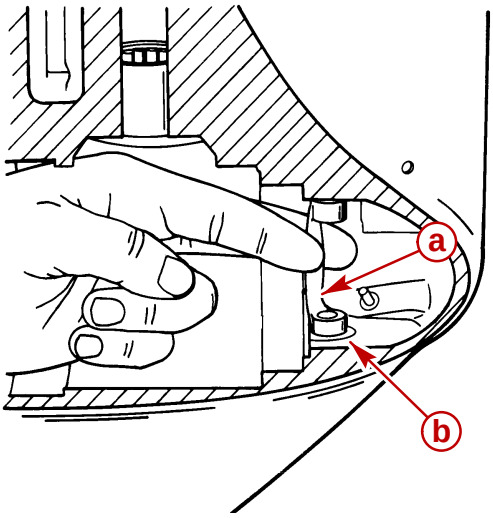
74009

a - Bearing Installation Tool (91-18605A1)
b - Cup Driver (91-31106)

Shift Shaft Assembly

INSTALLATION

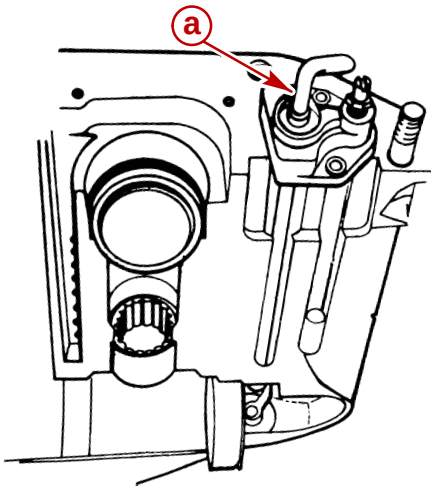
1. Place the shift crank onto the locating pin in the forward section of the gear housing. Ensure that the shift crank faces towards the left (port) side of the gear housing.



50314

a - Shift Crank
b - Locating Pin

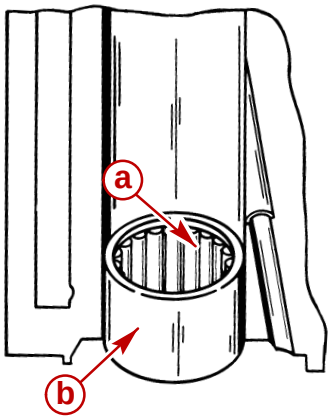
2. Install the shift shaft assembly into the gear housing as shown. Position the bent end of the shift shaft forward while installing it and ensure that the splined end of the shift shaft is engaged with the shift crank. Make sure that the O-rings are present and positioned properly. Install fasteners.



70620

a - Shift Shaft Assembly

NOTE: *If the pinion bearing needles have fallen out, install 18 needles into needle bearing outer race. Use Quicksilver Needle Bearing Assembly Lubricant, to help hold needles in place.*



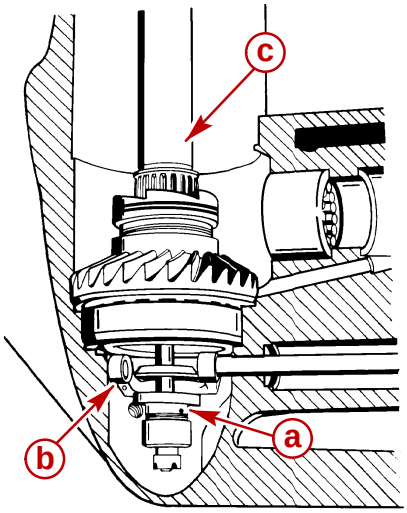
23142

a - Needles (18)
b - Roller Bearing Outer Race

Propeller Shaft Assembly

INSTALLATION

1. To allow for the engagement of the shift spool with the shift crank, tilt the propeller end of the propeller shaft assembly to the left (port) side of gear housing while installing.

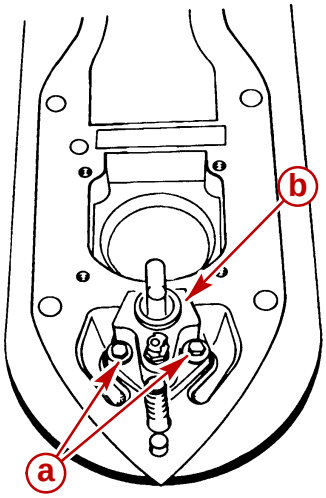


23343

a - Shift Actuating Spool
b - Shift Crank
c - Propeller Shaft Assembly

IMPORTANT: The shift shaft must point forward when the shaft is rotated clockwise. If it does not, lift it up slightly and realign the lower shift shaft splines into the shift crank. Recheck to make sure that it is now aligned correctly.

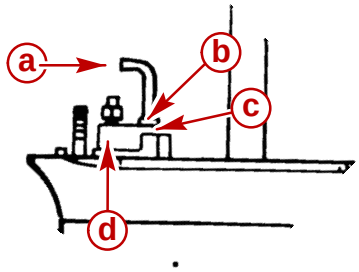
2. Operate the shift shaft to ensure that it has been properly installed. The sliding clutch should move forward when the shift shaft is turned clockwise. It should move aft when the shift shaft is turned counterclockwise.
3. Make sure that the O-rings are present and positioned correctly. Install the screws that secure the shift shaft bushing and torque them to 60 lb-in. (6.8 Nm). **Recheck the shift shaft alignment as noted in the preceding IMPORTANT.**



70888

a - Screws (2)
b - Shift Shaft Bushing

4. Slide the rubber sleeve at top end of shift shaft down so that it just touches the oil seal in the bushing.



70492

a - Shift Shaft
b - Rubber Sleeve
c - Oil Seal
d - Shift Shaft Bushing

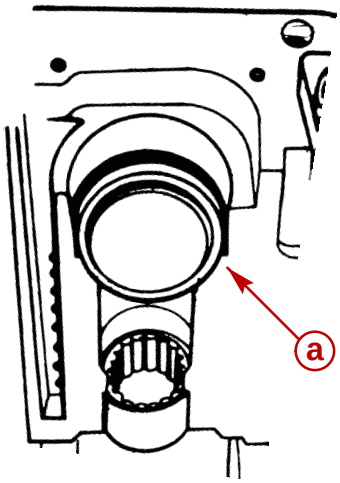
Drive Shaft and Pinion Gear

INSTALLATION

NOTE: *If the original shims were not retained or if pinion gear, drive shaft, drive shaft tapered roller bearing and cup, or gear housing were replaced, start off by installing a .030 in. (0.76 mm) shim(s).*

NOTE: *If the original shims were retained (or measurement known) and none of the above listed parts were replaced, reinstall the same shims or same amount of shims.*

1. Place the shim(s) into the drive shaft housing bore at the location shown.



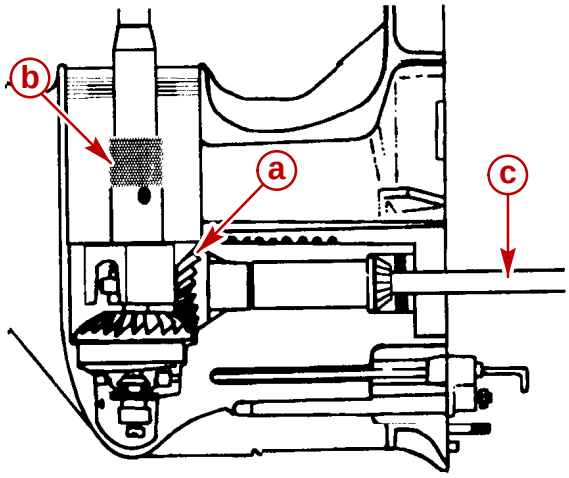
70620

a - Shim(s)

NOTE: *For ease of installation, glue the washer to the pinion gear, using 3M Adhesive (92-86166-1) or equivalent.*

2. Apply Loctite 271 to the threads of the pinion gear nut and assemble the pinion gear nut into the MR slot of the pinion nut adapter. A small amount of heavy grease in the slot of the pinion nut adapter while installing the drive shaft assembly.
3. Place the pinion gear and washer into the gear housing.
4. Insert the pinion nut adapter (with the nut) into the gear housing.
5. Insert the drive shaft into the gear housing drive shaft bore. It may be necessary to rotate the drive shaft to engage the drive shaft splines into the pinion gear splines.

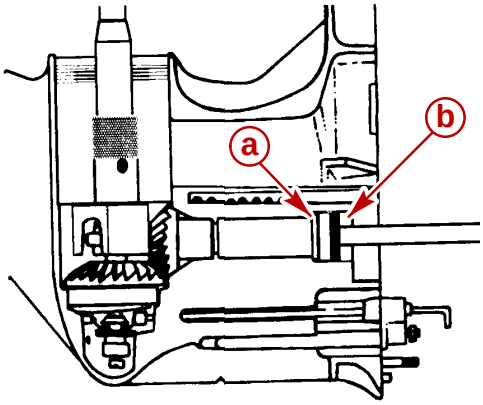
6. Start the pinion nut onto the drive shaft threads by rotating the drive shaft until the nut is snug.



70891

a - Pinion Gear (WIth The Washer Glued To The Tool)
b - Pinion Nut Adapter (91-61067 A3)
c - Drive Shaft

7. Install the drive shaft tapered roller bearing cup, then the retainer. Hand tighten.

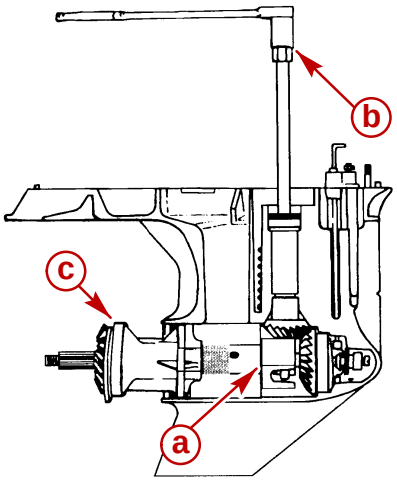


70890

a - Tapered Roller Bearing Cup
b - Drive Shaft Retainer

8. Install the bearing carrier into the gear housing backwards to hold the propeller shaft and the pinion nut adapter in position.

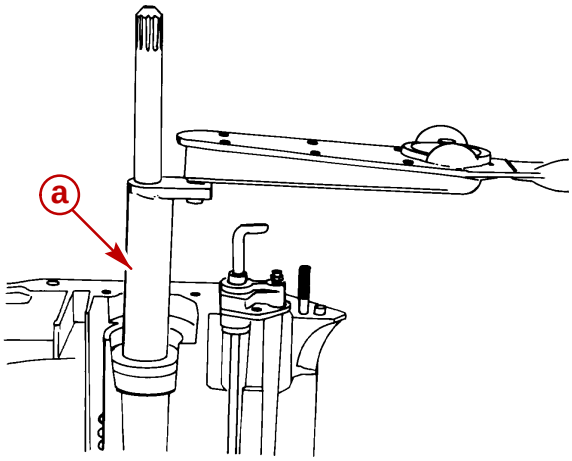
9. Torque the pinion nut (using the tools as shown) to 70 lb-ft (95 Nm).



70892

a - Pinion Nut Adaptor (91-61067 A3)
b - Drive Shaft Nut Wrench (91-56775)
c - Bearing Carrier (Installed Backwards)

10. Remove the bearing carrier, pinion nut adapter, propeller shaft assembly and drive shaft nut wrench.
11. Torque the retainer to 100 lb-ft (130 Nm).



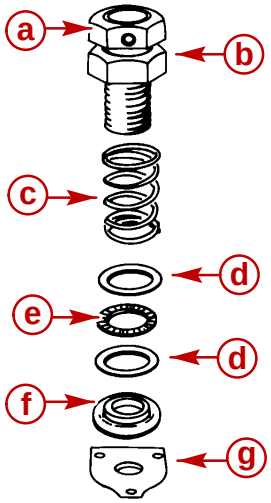
70711

a - Drive Shaft Bearing Retainer Wrench (91-43506)

Drive Shaft - Bearing Preload Tool

INSTALLATION

1. Install the components from the Bearing Preload Tool Kit (91-14311A2) over the drive shaft in the order shown.

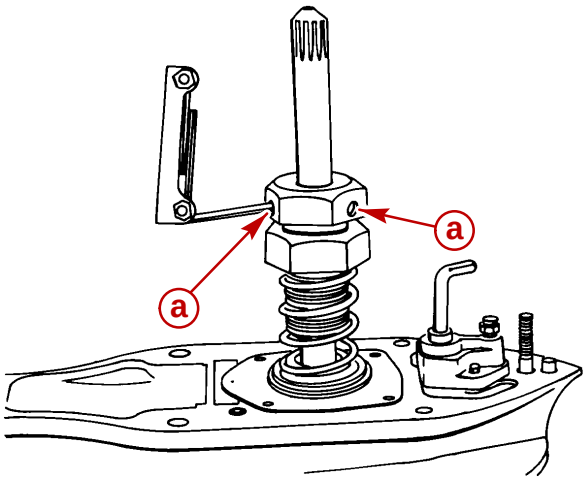


73885

a - Top Nut with Threaded Pipe
b - Nut
c - Spring
d - Thrust Washer
e - Thrust Bearing
f - Thrust Washer
g - Water Pump Face Plate (From Gear Housing)

NOTE: *Place the top two nuts as closely together as possible.*

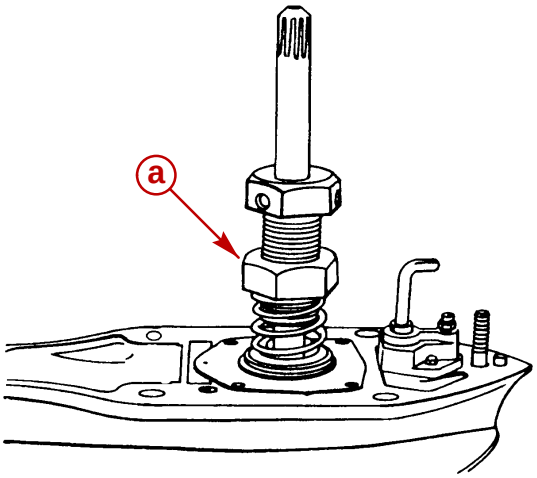
2. Pull up on the drive shaft and tighten the two (2) allen screws in the top nut of the bearing preload tool.



70716

a - Allen Screws

3. Screw the bottom nut of the bearing preload tool down until it is one inch further down the threaded rod than it was previously.



70893

a - Bottom Nut [Screwed Down Approximately 1 in. (25 mm) Further Than It Was Previously]

4. Rotate the drive shaft at least three full turns in a clockwise direction.

Pinion Gear Location

CHECKING AND ADJUSTING

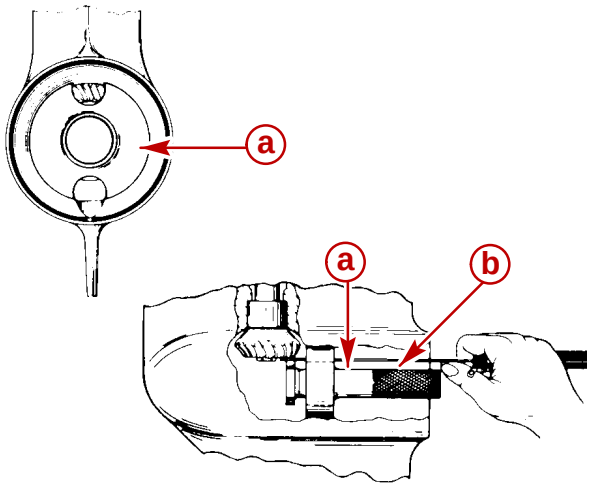
1. Place the pinion gear shimming tool into the gear housing.

NOTE: *Take the following measurements at 3 locations, rotating the drive shaft 120 degrees between each reading (always rotate the drive shaft in a clockwise direction).*

2. Insert the thickest feeler gauge that fits snugly between one tooth of the pinion gear and high point of the shimming tool.
3. Rotate the drive shaft 120 degrees in a clockwise direction and take another reading.
4. Repeat this process until 3 readings have been taken.
5. Add the three readings together and divide the sum by 3 to get the average pinion gear height. Make note of this average measurement.

NOTE: *The average pinion gear height should be .025 in. (0.64 mm).*

6. If the average pinion gear height is not correct, remove the bearing preload tool, the drive shaft retainer and the drive shaft tapered roller bearing cup. The cup can be removed by wiggling the drive shaft back and forth or by turning gear housing and shaking it. Add or subtract shims beneath the cup to obtain the proper average pinion gear height. Reinstall the cup and retainer. Retorque retainer to 100 lb-ft (135.8 Nm). Reinstall the bearing preload tool and rotate the drive shaft at least 3 full turns in a clockwise direction. Recheck the pinion gear height as in Step 5 above. Repeat this process until the average pinion gear height is within specification.



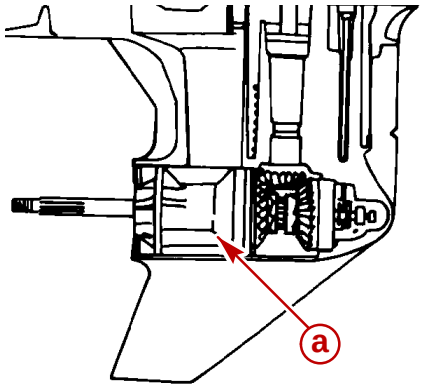
26410

a - Pinion Gear Shimming Tool (91-56048)
b - .025 in. (0.64 mm) Feeler Gauge

Bearing Carrier Assembly

INSTALLATION - FOR CHECKING BACKLASHES

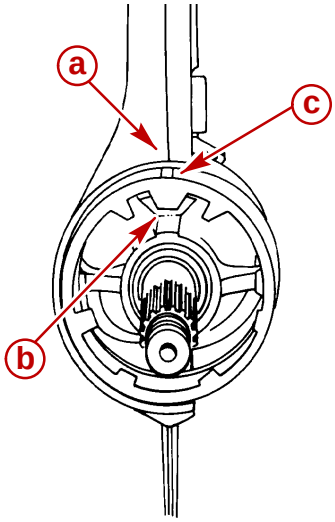
1. Place the bearing carrier assembly into the gear housing. It may be necessary to turn the drive shaft to align the teeth of the pinion and the reverse gears.



70712

a - Bearing Carrier Assembly

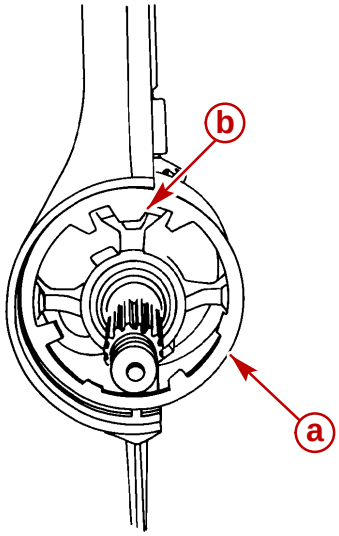
2. Align the bearing carrier “V” shaped notch with the alignment hole in the gear housing and then install the tab washer with the external tab inserted into the hole in the gear housing.



70713

a - Gear Case Alignment Hole
b - “V” Shaped Notch In Bearing Carrier
c - Alignment Tab Of Tab Washer

3. Ensure that the “V” shaped tab aligns with the “V” notch in the bearing carrier.

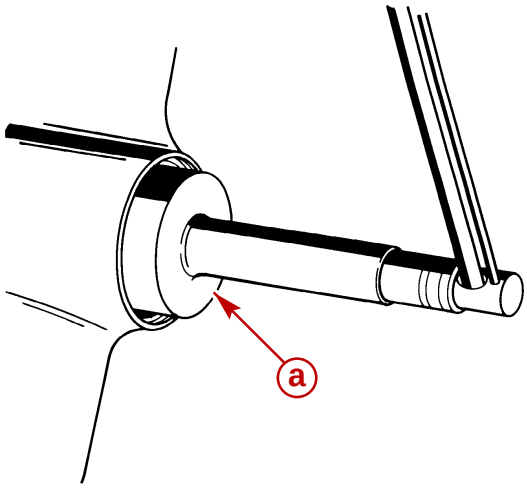


70714

a - Tab Washer
b - “V” Tab

4. Generously lubricate the bearing carrier retainer threads with Quicksilver Lubricant 101. Start the retainer into the gear housing threads and tighten it down fully by hand.

5. Torque the bearing carrier retainer to 210 lb-ft (285 Nm).



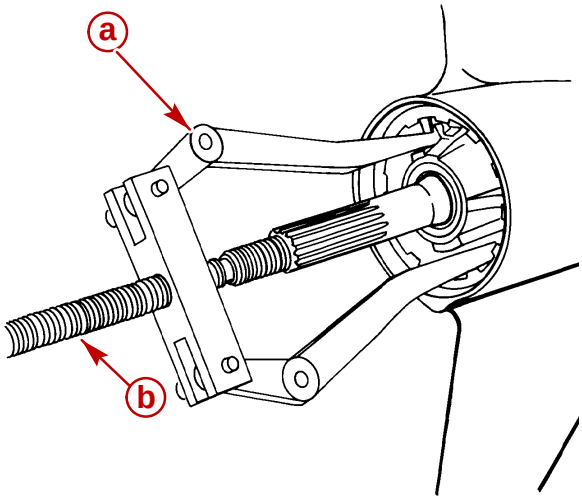
23355

a - Bearing Carrier Retainer Wrench (91-61069)

Forward Gear Backlash

CHECKING

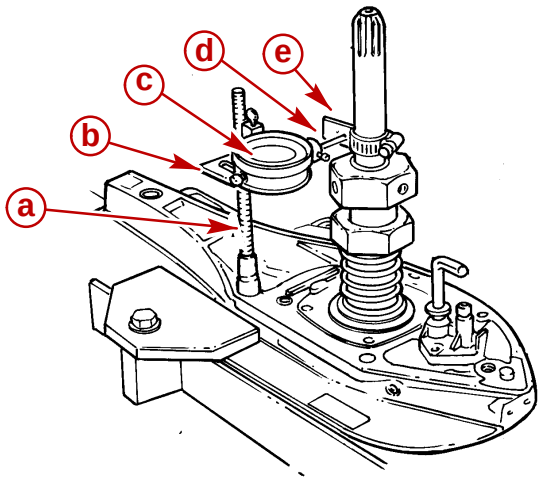
1. Apply forward pressure to propeller shaft as follows:
   a. Attach puller jaws and puller bolt onto bearing carrier bosses, if equipped, or on bearing carrier outer ring and propeller shaft.



70719

a - Puller Jaws
b - Puller Bolt

2. Torque the puller bolt to 45 lb-in. (5 Nm). Rotate the drive shaft three full turns clockwise and retorque the bolt to 45 lb-in. (5 Nm).
3. **For All Gears Except 14:28:** Install backlash indicator (P/N 91-58222 A1) and align the indicator pointer so that it is perpendicular to and touching the “I” mark on the indicator rod.
4. **For 14:28 Gears:** Install backlash indicator (91-78473) and align the indicator pointer so that it is perpendicular to and touching the “2” mark on the indicator rod.
5. Tighten the indicator rod onto the drive shaft and rotate the drive shaft so that the needle in the dial makes at least one full revolution and comes to “0” on the indicator scale.



77706

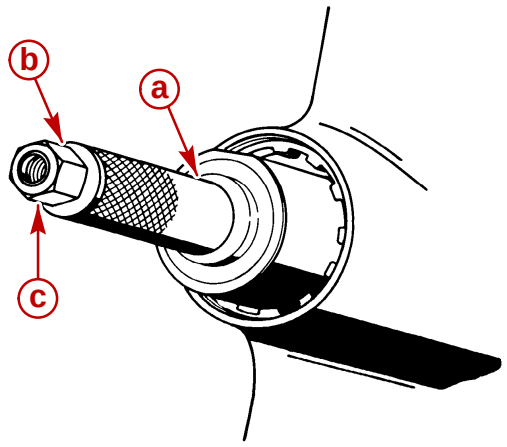
a - Threaded Rod [3/8 in. (9.5 mm) Obtain Locally]
b - Dial Indicator Holding Tool
c - Backlash Indicator
d - Indicator Pointer
e - Backlash Indicator Rod

6. Take the backlash readings by lightly turning the drive shaft back and forth, so as to feel the backlash between the gear. No movement should be noticed at the propeller shaft.
   a. Observe the backlash indicator and record the reading.
   b. Loosen the indicator rod and rotate the drive shaft 90 degrees in a clockwise direction.
   c. Repeat Step 2 above and take and record another reading. Repeat Step 3 until a total of 4 backlash readings have been taken.
7. Add the four readings together and divide the sum by four. This is your average backlash, make note of this figure, if it does not meet specifications of .017-.028 in. (0.43-0.71 mm) it will be adjusted at a later step.
8. Loosen the backlash indicator rod and remove the puller jaws.

Reverse Gear Backlash

CHECKING

1. Apply backward pressure on the propeller shaft as follows:
   a. Install the pinion nut adaptor, washer and propeller nut.

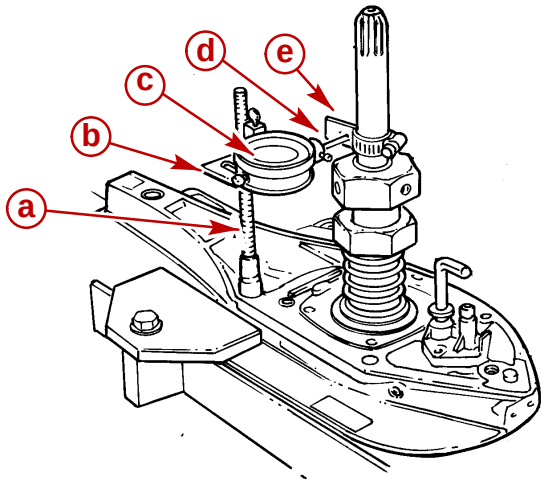


23355

a - Pinion Nut Adaptor (91-61061 A2)
b - Washer (12-54048)
c - Prop Nut

   b. Torque the propeller nut to 45 lb-in. (5 Nm). Rotate the drive shaft 3 full turns in a clockwise direction and retorque the propeller nut to 45 lb-in. (5 Nm).
2. **For All Gears Except 14:28:** Install backlash indicator (P/N 91-58222 A1) and align the indicator pointer so that it is perpendicular to and touching the “I” mark on the backlash indicator rod.
3. **For 14:28 Gears:** Install backlash indicator (91-78473) and align the indicator pointer so that it is perpendicular to and touching the “2” mark on the backlash indicator rod.

4. Tighten the indicator rod onto the drive shaft and rotate the drive shaft so that the needle in the dial makes at least one full revolution and comes to “0” on the dial indicator scale.



77706

a - Threaded Rod [3/8 in. (9.5 mm) Obtain Locally]
b - Dial Indicator Holding Tool
c - Backlash Indicator
d - Indicator Pointer
e - Backlash Indicator Rod

5. Take the backlash readings by lightly turning the drive shaft back and forth, so as to feel the backlash between the gears, (no movement should be noticed at the propeller shaft).
   a. Observe the backlash indicator and record the reading.
   b. Loosen the indicator rod and rotate the drive shaft 90 degrees in a clockwise direction.
   c. Repeat Step 4 above and take and record another reading. Repeat Step 5 until a total of 4 backlash readings have been taken.

NOTE: *The backlash reading of .028-.052 in. (0.71-1.32 mm) applies to both earlier model reverse gears and the later model reverse gear and thrust washer combination.*

6. Loosen the backlash indicator rod and remove the propeller nut, washer and pinion nut adaptor. Remove the backlash indicator and all its mounting components. **Do not remove the bearing preload tool; the following instructions give specific instructions for its removal.**

Forward and/or Reverse Gear Backlash Adjustment

	SPECIFICATION	
	inches	millimeters
Forward Gear Backlash	.017-.028	0.43-0.71
Reverse Gear Backlash	.028-.060	0.71-1.32

1. **If the forward gear backlash is not within specification**
   a. Ensure that the bearing is all the way onto the gear.
   b. Ensure that the bearing race is all the way into the gear housing.
   c. Ensure that appropriate amount of shims were installed beneath forward gear bearing cup.
2. **If the reverse gear backlash is not within specification**
   a. Check that bearing is completely pressed on gear.
   b. Check bearing carrier assembly to ensure reverse gear bearing is completely seated in the bearing carrier.
   c. Check bearing carrier I.D. If oversize, replace bearing carrier.

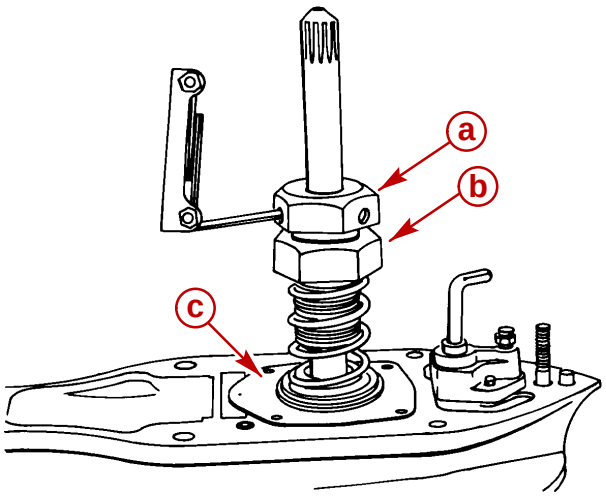
Drive Shaft - Bearing Preload Tool

REMOVAL

⚠ CAUTION

Before loosening the top nut allen screws of the bearing preload tool, screw the bottom nut up as close as possible to the top nut or shaft will be damaged.

1. Loosen the bottom nut of the bearing preload tool until it is as close as possible to top nut.
2. Loosen the allen screws in the top nut.
3. Remove all components including the water pump face plate.



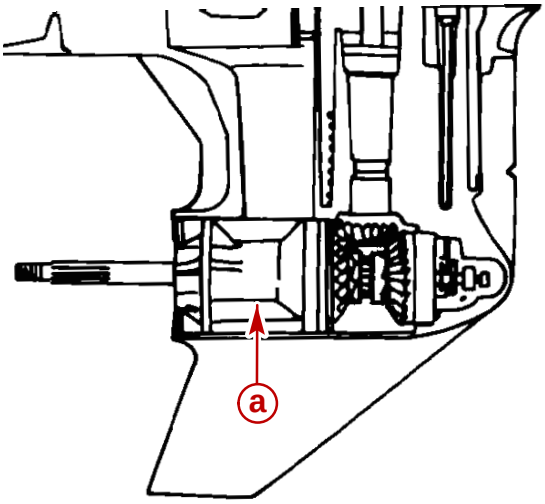
70716

a - Top Nut (With Allen Screws)
b - Bottom Nut
c - Water Pump Face Plate

Bearing Carrier Assembly

Final Installation

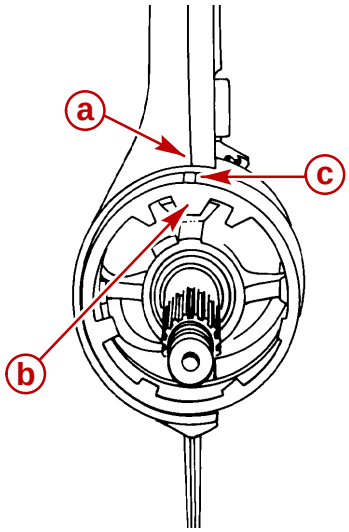
1. Remove the Bearing Carrier and lubricate the following as specified:
   a. Lubricate both the forward and aft outer diameters of the bearing carrier with Quicksilver Perfect Seal.
   b. Fill the space between the carrier oil seals with Quicksilver 2-4-C Marine Lubricant with Teflon.
2. Place the bearing carrier assembly into the gear housing. It may be necessary to turn the drive shaft to align the teeth of the pinion and the reverse gears.



70712

a - Bearing Carrier Assembly

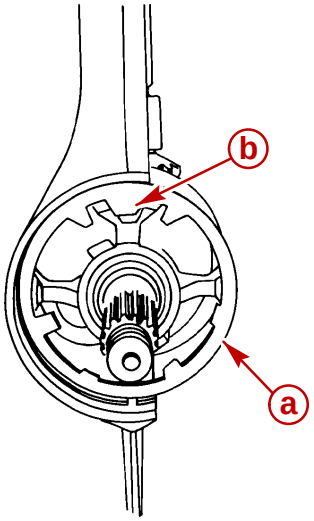
3. Align the bearing carrier “V” shaped notch with the alignment hole in the gear housing and then install the tab washer with the external tab inserted into the hole in the gear housing.



70713

a - Gear Case Alignment Hole
b - “V” Shaped Notch In Bearing Carrier
c - Alignment Tab Of Tab Washer

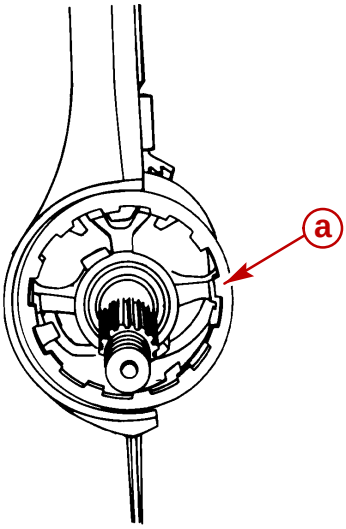
4. Ensure that the “V” shaped tab aligns with the “V” notch in bearing carrier.



70714

a - Tab Washer
b - “V” Tab

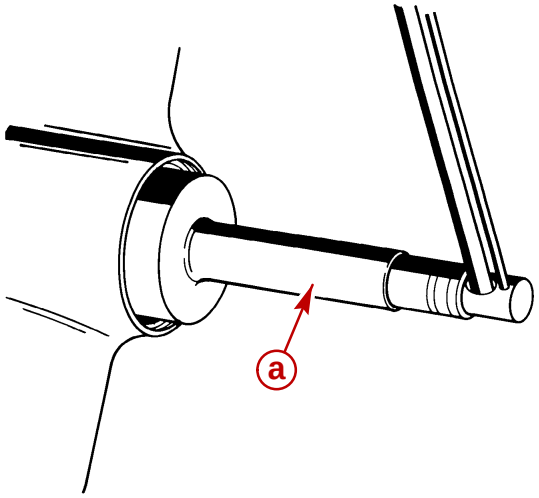
5. Generously lubricate the bearing carrier retainer threads with Quicksilver Lubricant 101. Start the retainer into the gear housing threads and screw it down fully by hand.



70715

a - Bearing Carrier Retainer

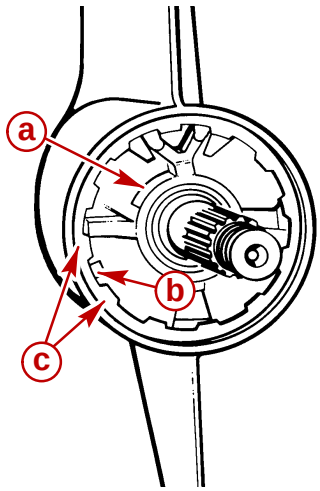
6. Torque the bearing carrier retainer to 210 lb-ft (285 Nm). Ensure that one tab lines up in the notched space between two of the retainer teeth. Tighten the retainer further, if necessary.



23355

a - Bearing Carrier Retainer Wrench (91-61069)

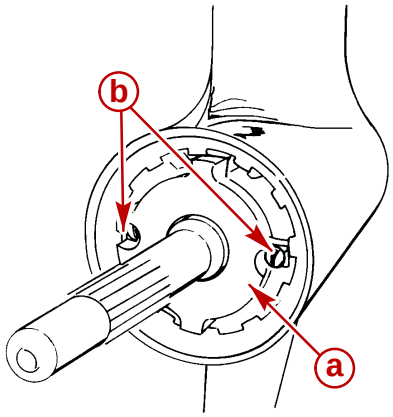
7. Bend one tab aft (outward) into a space between two of the notches of the retainer. Bend all the remaining tabs forward (inward).



70490

a - Bearing Carrier
b - Tab
c - Retainer Notches

8. **If equipped**, install anode plate to bearing carrier.



71958

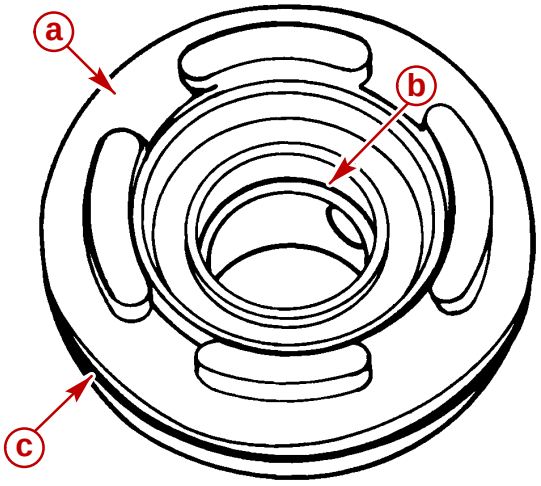
a - Anode
b - Screws

Oil Seal Carrier Assembly

Installation

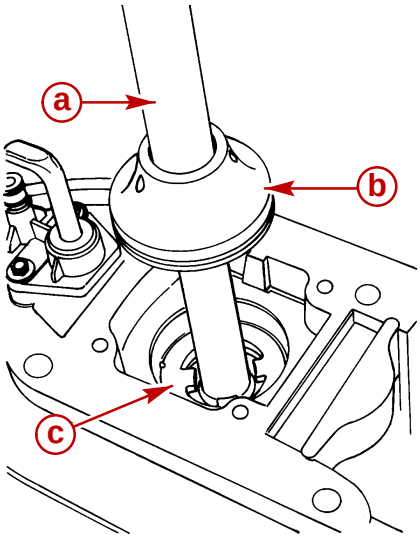
NOTE: *Do not hammer the oil seal carrier into position, apply hand pressure only to install.*

1. Lubricate the oil seal carrier oil seal lips and O-ring with Quicksilver 2-4-C Marine Lubricant with Teflon and install the oil seal carrier over the drive shaft and into the gear case.



70501

a - Oil Seal Carrier
b - Oil Seal Lips
c - O-ring



75685

a - Drive Shaft
b - Oil Seal Carrier
c - Retainer Nut

Water Pump Assembly

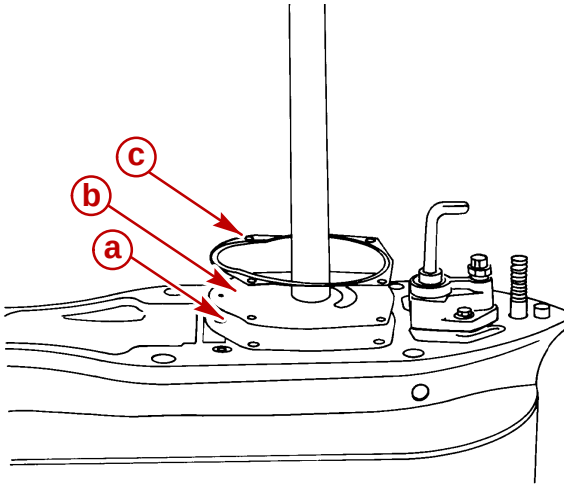
Installation

NOTE: *The aluminum dam has been changed to a rubber filler plug. If the aluminum water pump dam in the gear housing has become corroded or damaged, it can be replaced with the rubber filler plug.*

IMPORTANT: The gaskets/face plate hole pattern is not symmetrical. If the holes of the gaskets/face plate do not align with the screw holes of the gear case and/or each other, one or more of the parts is upside down. Determine which part(s) is (are) upside down and turn the appropriate part(s) over.

1. Apply Quicksilver Perfect Seal to the small hole gasket. Place the small hole gasket, the face plate and the large hole gasket onto the gear case.

NOTE: *Add Quicksilver Perfect Seal to the gasket to seal it and prevent water from seeping into the gear housing.*



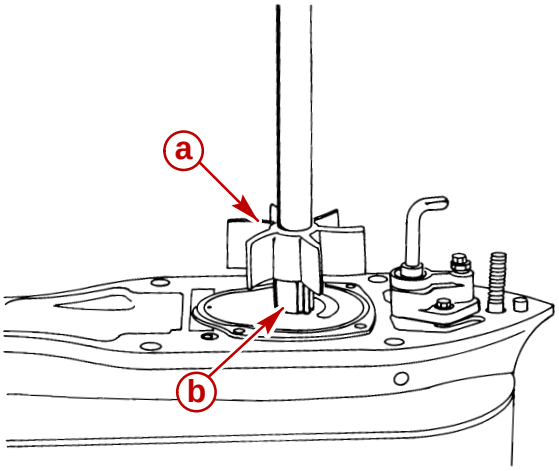
70720

a - Small Hole Gasket
b - Face Plate
c - Large Hole Gasket

2. Place a small amount of Quicksilver 2-4-C Marine Lubricant with Teflon on the flat surface of the impeller key and assemble the key onto the drive shaft keyway.

IMPORTANT: When using an impeller whose blades have taken a set, face the curl of the blades in a counterclockwise direction. DO NOT install the impeller with its blades oriented in a reversed direction from original rotation, or premature impeller failure <u>will</u> occur.

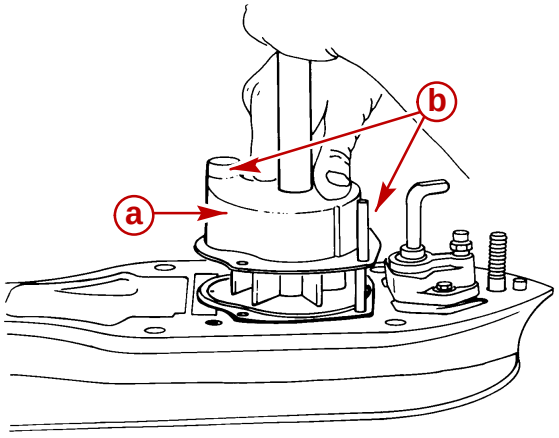
3. Assemble the water pump impeller onto the drive shaft and down over the key.



70721

a - Water Pump Impeller
b - Water Pump Impeller Key

4. On early models, install the two (2) water pump locating pins through the gaskets and face plate.
5. Position the water pump body over the drive shaft and water pump locating pins. Rotate the drive shaft in a clockwise direction, while pushing down on the water pump body to ease the water pump over the impeller blades.



70722

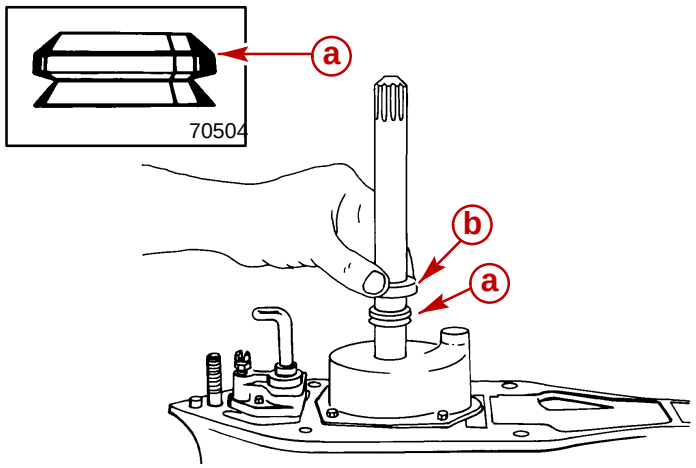
a - Water Pump Body
b - Water Pump Alignment Pins (91-821571A1)
c - Drive Shaft (Turn Clockwise While Installing Water Pump Body)

NOTE: *Apply Quicksilver Perfect Seal to all four(4) screw threads before installation.*

6. Hand start two (2) fasteners into the water pump assembly and remove the water pump locating pins. Assemble the remaining two (2) fasteners. Run all fasteners down and torque to 60 lb-in. (7.9 Nm).

IMPORTANT: The water pump face seal must be installed as outlined below. Improperly installing the water pump face seal may result in premature failure of the unit.

7. Assemble the water pump face seal to a position approximately 1/2 of the way down the drive shaft. Assemble the water pump face seal setting tool over the drive shaft and push the seal down onto the water pump with the tool while pulling up on the drive shaft. Remove the tool from the drive shaft.



70708

a - Water Pump Face Seal
b - Water Pump Face Seal Setting Tool

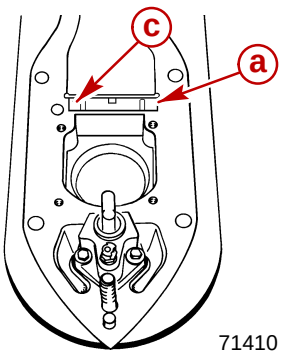
8. Lightly lubricate the O-rings in the water tube coupling with Quicksilver 2-4-C Marine Lubricant with Teflon. Assemble the water tube sleeve into the water tube coupling.
9. Assemble the water tube coupling assembly to the water pump ensuring that the O-rings are not damaged during assembly.

Joining Drive Shaft Housing/Gear Housing

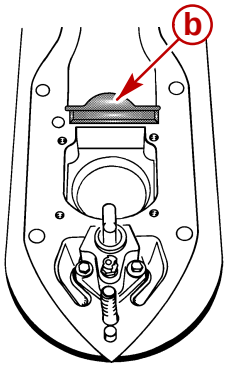
1. Lubricate the end of the water tube (in the drive shaft housing) and the splines of the drive shaft with Quicksilver 2-4-C Marine Lubricant with Teflon.

NOTE: *The aluminum dam has been changed to a rubber filler plug. If the aluminum water pump dam in the gear housing has become corroded or damaged, it can be replaced with the rubber filler plug.*

IMPORTANT: Ensure that the drain hole of the aluminum water pump dam is not clogged with any foreign material as damage may occur if it is.



71410

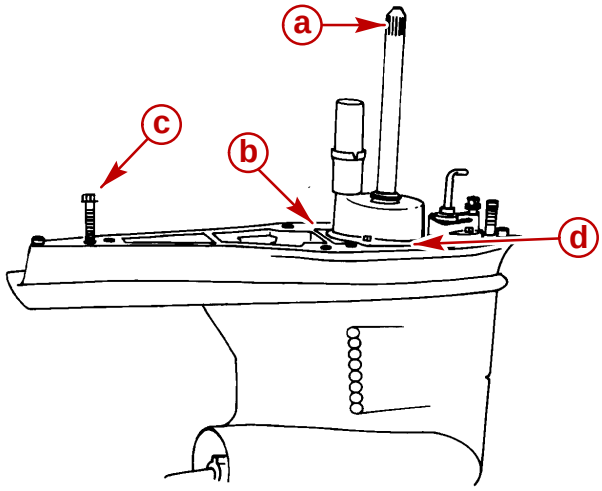


71436

a - Aluminum Dam
b - Rubber Filler Plug
c - Drain Hole

2. Units with an aluminum dam installed in them will require a bead of Permatex Ultra Blue Silicone Sealant along the top of the water pump dam as shown. If rubber filler plug is present, it is not necessary to use this sealant.
3. To replace the aluminum dam if it has been removed and undamaged, place a bead of Permatex Ultra Blue Silicone Sealant down both sides of it.

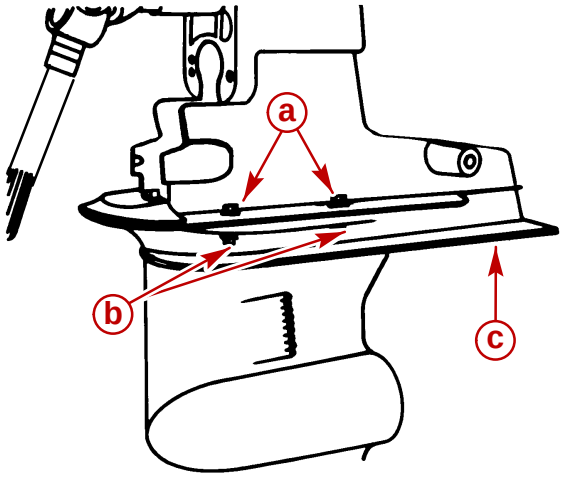
4. Ensure that the water pump dam in the drive shaft housing is present and installed correctly. Ensure that all parts are present on the gear housing and the drive shaft housing.



70710

a - Drive Shaft Splines
b - Sealant - Aluminum Dam Only
c - Trim Tab Bolt (Insert In Aft Hole)
d - Quad Ring

5. Position the drive shaft housing straight above the gear housing. Align the water tube sleeve with the water tube and the drive shaft with the upper drive gear and assemble the drive shaft housing to the gear housing. It may be necessary to rotate the propeller shaft or the u-joint to align the drive shaft splines with the upper drive gear splines.
6. Assemble the front nut to the front stud of the unit.
7. Assemble the aft screw and star washer (into the forward hole in the trim tab well of the gear housing).
8. Assemble the bolts, nuts and washers to the port and starboard sides of the unit. Torque to 35 lb.ft. (47.5 Nm).



70117

a - Nuts, Bolts, Washers
b - Nut
c - Screw

9. Assemble the trim tab and align it to the mark made previously on the gear housing. Torque the screw to 23 lb-ft (31 Nm).

10. Position or lower drive unit so anti-ventilation plate is level.
11. Refill drive unit with gear lube. Refer to section 1B.

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STERNDRIVE UNIT

Section 3C - Gear Housing (Counter Rotation)

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3C

Specifications

Torque Specifications

Description	Torque
Screws - Water Pump Body	60 lb-in. (6.8 Nm)
Nut - Pinion Gear	70 lb-in. (95 Nm)
Screw - Gear Housing to Drive Shaft Housing	28 lb-ft (38 Nm)
Nuts - Gear Housing to Drive Shaft Housing	35 lb-ft (47 Nm)
Screw - Trim Tab	23 lb-ft (31 Nm)
Screws - Shift Shaft Bushing	60 lb-in. (6.8 Nm)
Retainer - Drive Shaft	100 lb-ft (136 Nm)
Retainer - Bearing Carrier	210 lb-ft (285 Nm)
Propeller Nut	55 lb-ft (75 Nm) MINIMUM
Oil Fill/Drain Plug	40 lb-in. (4.52 Nm)

Shimming Specifications

NOTE: *All bearing preload devices must be properly installed to check all gear locations and backlashes.*

Gear Description	Gear Location
Pinion Gear Height	.025 in. (0.64 mm)
Forward Gear Backlash	.023 in. (0.58 mm)
Reverse Gear Backlash	.055 in. (1.4 mm)

Lubricants/Sealers/Adhesives

Description	Part Number
3m Brand Adhesive	92-86166Q1
Quicksilver 2-4 C Marine Lubricant With Teflon	92-825407A12
Quicksilver Needle Bearing Assembly Lubricant	92-825265A1
Quicksilver Perfect Seal	92-34227-1
Permatex Ultra Blue Silicone Sealant	Obtain Locally
Quicksilver Special Lubricant 101	92-13872A1
Loctite 27131	92-809820
Quicksilver High Performance Gear Lube	92-816026A1

Special Tools

Description	Tool Part Number
Backlash Indicator Rod (All Gears Except 14:28)	91-53459

Backlash Indicator Rod (14:28 Gears)	91-78473
Bearing Adaptor Installation Tool	91-18605 A2
Bearing Carrier Retainer Wrench	91-61069T
Bearing Driver	91-816244
Bearing Preload Tool	91-14311 A2
Bearing Removal Tool	91-816245
Belleville Washer	12-54048
Dial Indicator	91-58222 A1
Dial Indicator Holding Tool	91-89897
Drive Shaft Nut Wrench	91-56775T
Drive Shaft Bearing Retainer Wrench	91-43506T
Guide Plate	91-816243
Needle Bearing Driver	91-15755T
Oil Seal Driver	91-31108T
Oil Seal Driver	91-817569T
Pinion Gear Shimming Tool	91-56048T
Pinion Nut Adaptor	91-61067 A3

Special Tools (continued)

Description	Tool Part Number
Drive Shaft Adaptor	91-61077T
Puller Bolt	91-85716
Puller Shaft	91-31229
Puller Jaws	91-46086 A1
Puller Jaws	91-816242
Slide Hammer Puller	91-34569 A1
Forward Gear Installation Tool	91-815850
Torque Wrench (Inch Pound)	91-66274
Universal Puller Plate	91-37241
Water Pump Alignment Pins	91-821571 A1
Universal Bearing Removal And Installation Tool	91-31229 A7
Driver Head	91-36569T
Driver Head Rod	91-37323
Nut	11-24156
Pilot Washer	91-36571T
Puller Plate	91-29310
Puller/Driver Head	91-38628T
Reverse Gear Bearing Tool	91-807944T

*The 91-14311A2 Bearing Preload Tool is also used on Mercury and Mariner V-6 gear cases. Check your inventory before buying.

NOTE: *Water Pump Face Seal Tool is not available separately, 26-816575A2 is a kit part number which includes the tool and the face seal.*

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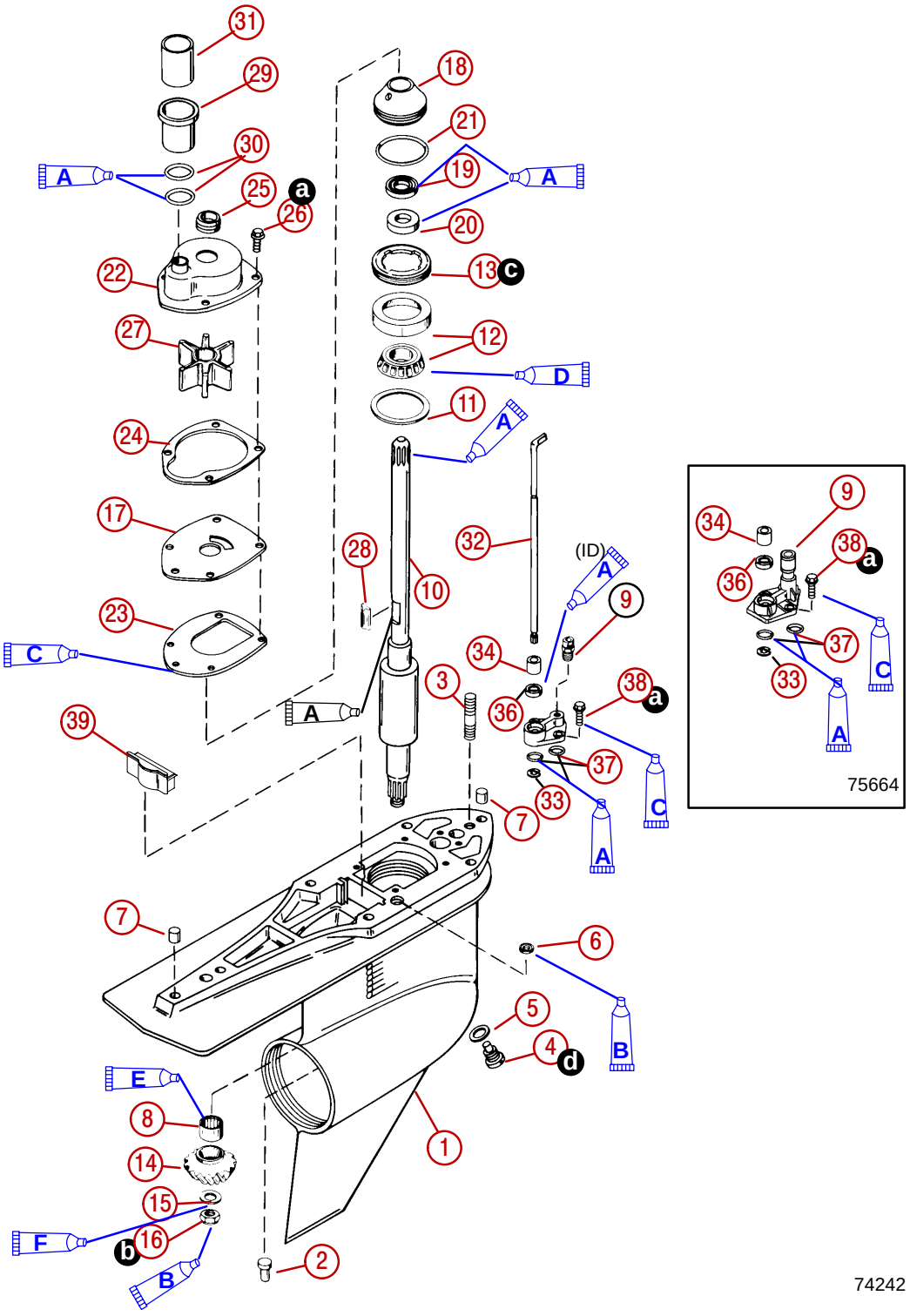
Counter-Rotation Gear Housing Exploded Parts View

Drive Shaft Components



1 - Gear Housing
2 - Pin
3 - Stud
4 - Screw
5 - Oil Fill/Drain Screw O-ring
6 - Quad Seal
7 - Dowel Pin
8 - Roller Bearing
9 - Speedometer Fitting
10 - Drive Shaft
11 - Shim
12 - Bearing And Cup
13 - Retainer Nut
14 - Gear Drive
15 - Washer
16 - Nut
17 - Face Plate
18 - Carrier
19 - Oil Seal
20 - Oil Seal
21 - O-ring
22 - Water Pump Body
23 - Gasket
24 - Gasket
25 - Face Seal
26 - Screw (4)
27 - Impeller
28 - Impeller Key
29 - Coupling
30 - O-rings
31 - Sleeve
32 - Shift Shaft
33 - Retaining Ring
34 - Sleeve
35 - Bushing Assembly
36 - Oil Seal
37 - O-rings
38 - Screw (2)
39 - Stuffer Plug

Lubricants/Sealers/Adhesives

- Quicksilver 2-4-C Marine Lubricant with Teflon

- 3M Brand Adhesive

- Loctite 27131

- Quicksilver High Performance Gear Lube

- Quicksilver Needle Bearing Assembly Lubricant

-Permatex Ultra Blue Silicone Sealant

Torque Specifications

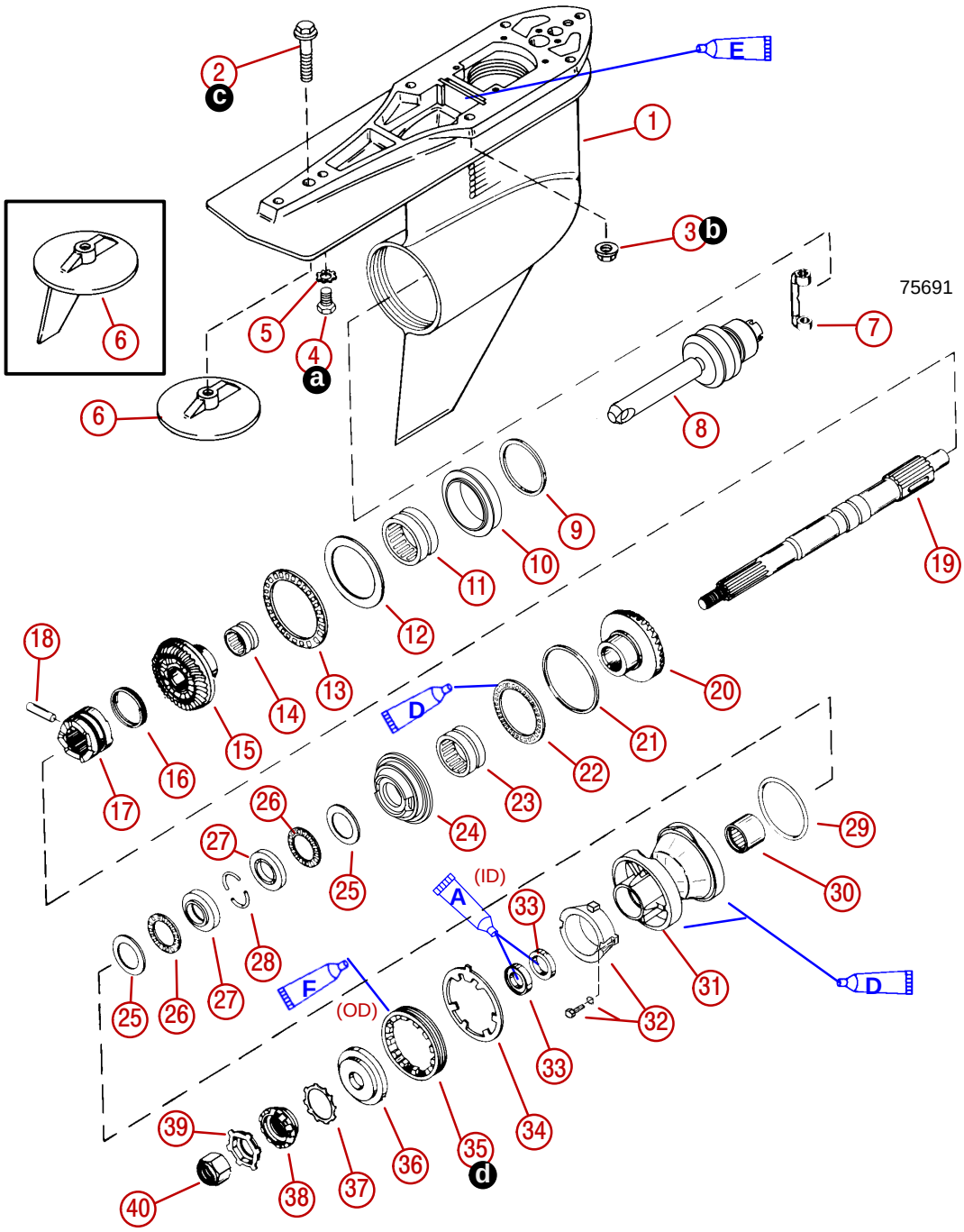
ⓐ . . . . . 60 lb-in. (6.8 Nm)

ⓑ . . . . . 70 lb-ft (95 Nm)

ⓒ . . . . . 100 lb-ft (136 Nm)

ⓓ . . . . . 40 lb-in. (4.52 Nm)

Propeller Shaft Components



1 - Gear Housing
2 - Screw - Trim Plate Or Tab
3 - Nut
4 - Screw
5 - Lockwasher
6 - Anodic Plate Or Tab
7 - Shift Crank
8 - Shift Spool Assembly
9 - Shims
10 - Bearing Adapter - Reverse Gear
11 - Roller Bearing
12 - Thrust Washer
13 - Thrust Bearing
14 - Roller Bearing
15 - Reverse Gear
16 - Retainer Spring - Cross Pin
17 - Clutch
18 - Cross Pin
19 - Propeller Shaft
20 - Forward Gear
21 - Shim Spacer
22 - Thrust Bearing
23 - Roller Bearing
24 - Bearing Adapter - Forward Gear
25 - Thrust Washer
26 - Thrust Bearing
27 - Thrust Race
28 - Keepers
29 - O-ring
30 - Needle Bearing
31 - Bearing Carrier
32 - Propeller Anode And Screws
33 - Seals
34 - Tab Washer
35 - Retaining Nut
36 - Thrust Hub
37 - Continuity Washer
38 - Spline Washer
39 - Tab Washer
40 - Locknut

Lubricants/Sealers/Adhesives

- Quicksilver 2-4-C Marine Lubricant with Teflon

- 3M Brand Adhesive

- Quicksilver Needle Bearing Assembly Lubricant

- Quicksilver Perfect Seal

- Permatex Ultra Blue Silicone Sealant

-Quicksilver Special Lubricant 101

- Loctite 27131

- Quicksilver High Performance Gear Lube

Torque Specifications

ⓐ . . . . . 28 lb-ft (38 Nm)

ⓑ . . . . . 35 lb-ft (47 Nm)

ⓒ . . . . . 23 lb-ft (31 Nm)

ⓓ . . . . . 210 lb-ft (285 Nm)

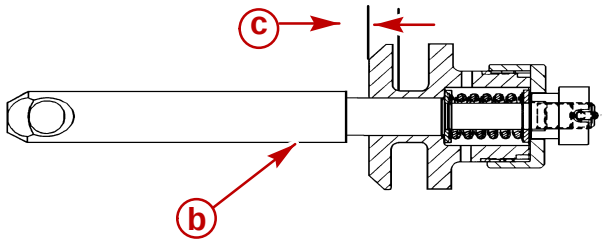
Special Information

⚠ CAUTION

Avoid damage to sterndrive unit. Drive unit damage will occur if Later Style parts are intermixed with Earlier Style parts.

Shift Spool Assembly

The later style shift spool assembly for the counter rotation has a larger gap than the earlier style. This later style shift spool, beginning with serial number 0F726586, is sold as a whole assembly and must be used when replacing the earlier style (Prior to S/N 0F726586).



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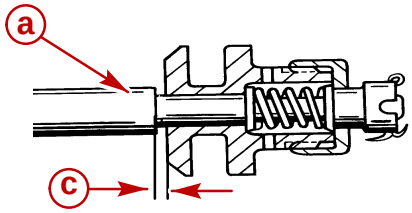
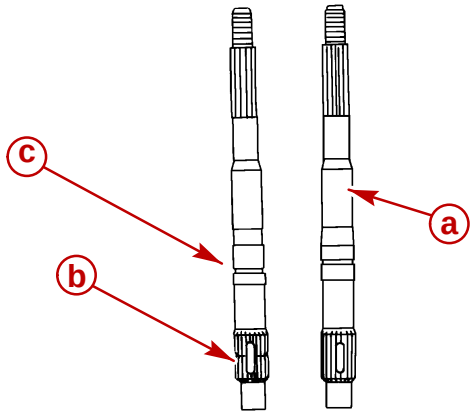


75219

a - Earlier Style Shift Spool Assembly (Prior to S/N 0F726586)
b - Later Style Shift Spool Assembly (S/N 0F726586 and Above)
c - End Play Measurement

Propeller Shaft

The later style propeller shaft has a groove on the shaft where the clutch slides onto the shaft. The keeper slot is also moved toward the forward end of the shaft.

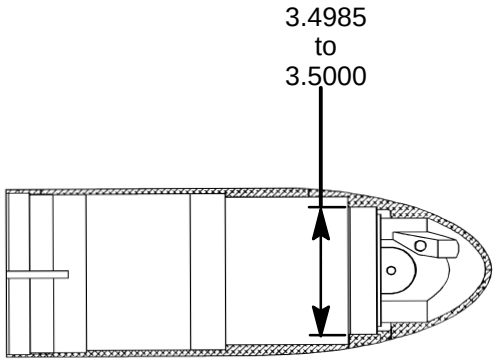


75223

a - Earlier Style Propeller Shaft (Prior To S/N 0F680000)
b - Later Style Propeller Shaft (S/N 0F680000 And Above)

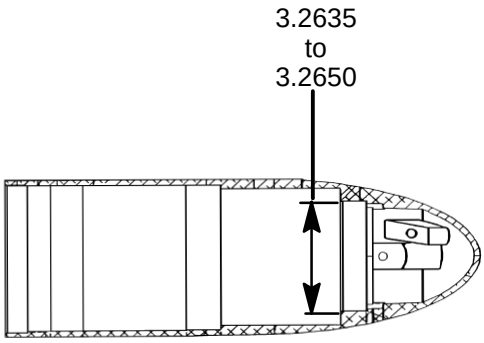
Forward Gear Bearing Bore

The later style forward gear bearing bore is smaller (3.2635 to 3.2650 in.) than the earlier style (3.4985 to 3.5000 in.)This slightly smaller bearing bore for the forward gear bearing adaptor is approximately 1/4 in. (6.3 mm) smaller.



75241

Earlier Style Forward Gear Bore (Prior To S/N 0F680000)

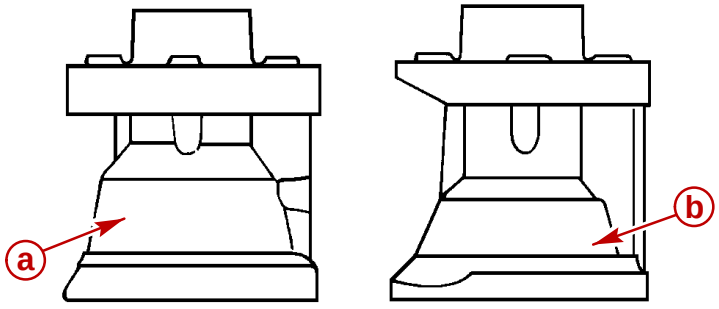


75248

Later Style Forward Gear Bore (S/N 0F680000 And Above)

Bearing Carrier

The later style bearing carrier is somewhat slimmer and about an 1/8 of an inch taller than the earlier style bearing carrier.

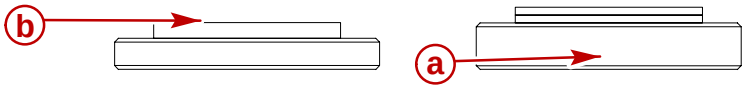


75231

a - Earlier Style Bearing Carrier (Prior To S/N OF680000)
b - Later Style Bearing Carrier (S/N OF680000 And Above)

Thrust Collar

The later style thrust collar is thinner than the earlier style, but still maintains the same diameter.

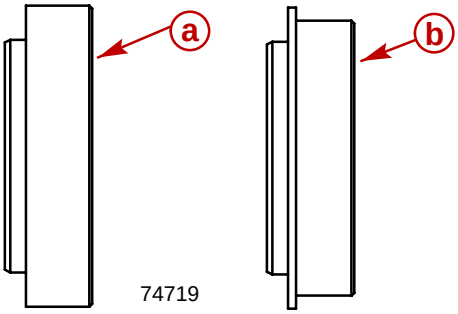


75220

a - Earlier Style Thrust Collar (Prior To S/N OF680000)
b - Later Style Thrust Collar (S/N OF680000 And After)

Reverse Gear Bearing Adaptor

The later style reverse gear bearing adaptor has a smaller diameter than the earlier style adaptor and is designed to fit into the smaller bore gear housing.

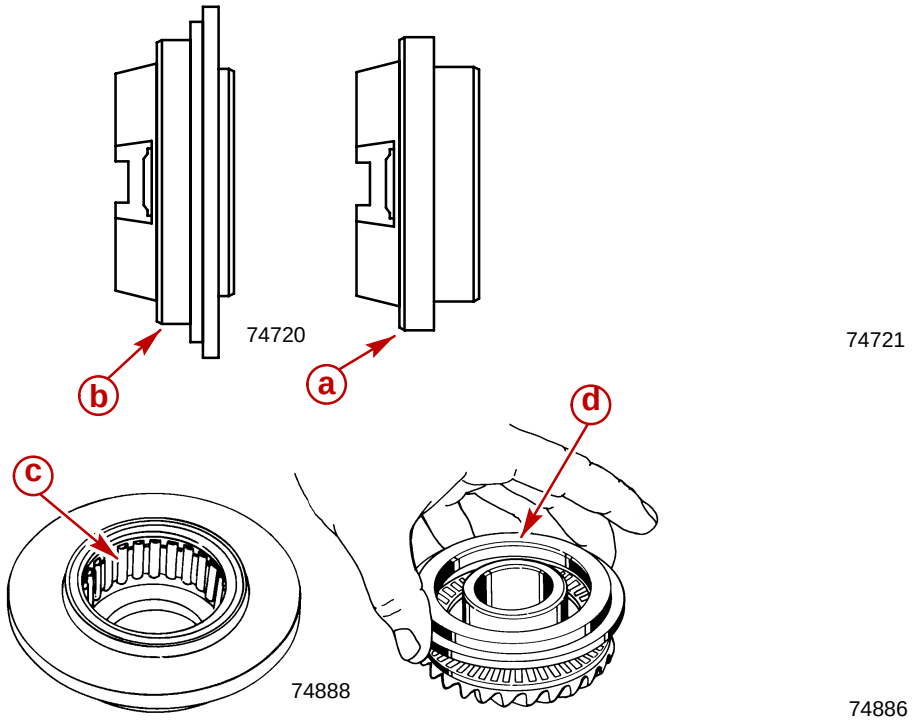


74719 74718

a - Earlier Style Reverse Gear Bearing Adaptor (Prior To S/N OF680000)
b - Later Style Reverse Gear Bearing Adaptor (S/N OF680000 and Above)

Forward Gear Bearing Adaptor

The forward gear bearing adaptor has the needle bearing pressed into the adaptor. For future reference, the needle bearing inside the bearing adapter does not require a special driver. The needle bearing is pressed into the adaptor until the bearing is flush with the edge of the adaptor bore.



a - Earlier Style Forward Gear Bearing Adaptor (Prior To S/N 0F680000)
b - Later Style Forward Gear Bearing Adaptor (S/N 0F680000 And Above)
c - Later Style Forward Gear Bearing Adaptor Needle Bearing
d - Earlier Style Thrust Washer

Pre-Disassembly Inspection

Propeller

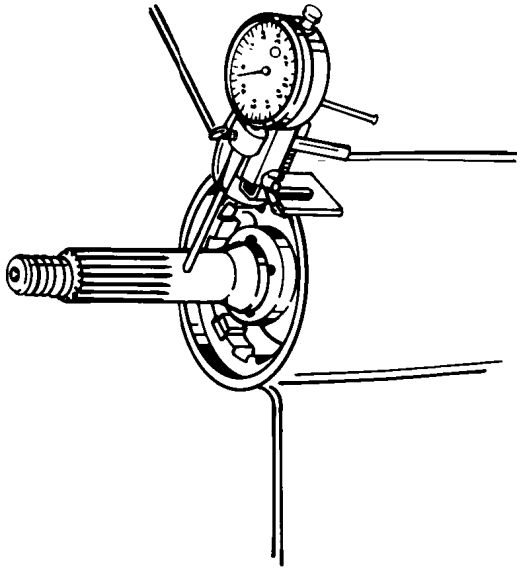
REMOVAL

1. If not already accomplished remove the propeller and its mounting components.

Propeller Shaft

INSPECTION

1. Inspect the propeller shaft for side to side movement, as follows:
   a. Position the dial indicator on the propeller shaft.
   b. Push the propeller shaft to one side and zero the dial indicator.
   c. Move the propeller shaft to the opposite side while observing the dial indicator.A shaft deflection of more than .003 in. (0.08 mm) indicates a worn propeller shaft bearing.
2. Check for a bent propeller shaft as follows:
   a. Rotate the drive shaft in gear while observing the dial indicator. If the deflection is more than .007 in. (0.178 mm), a bent propeller shaft is indicated.

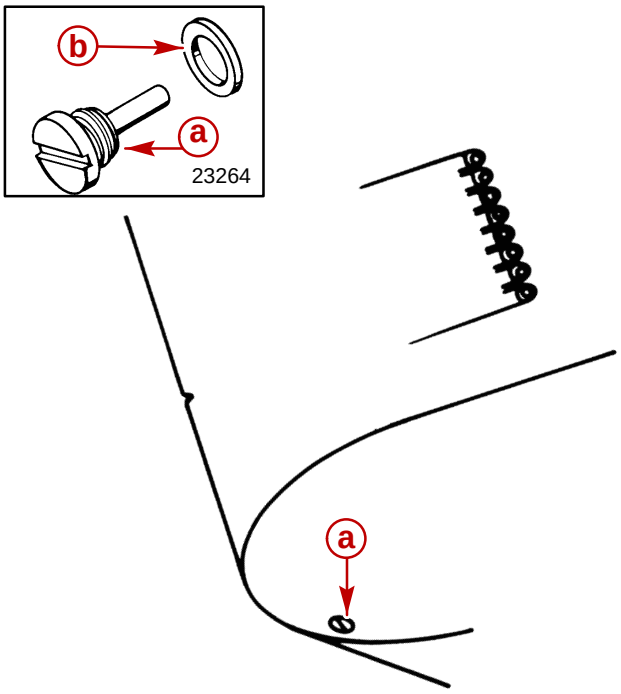


22086

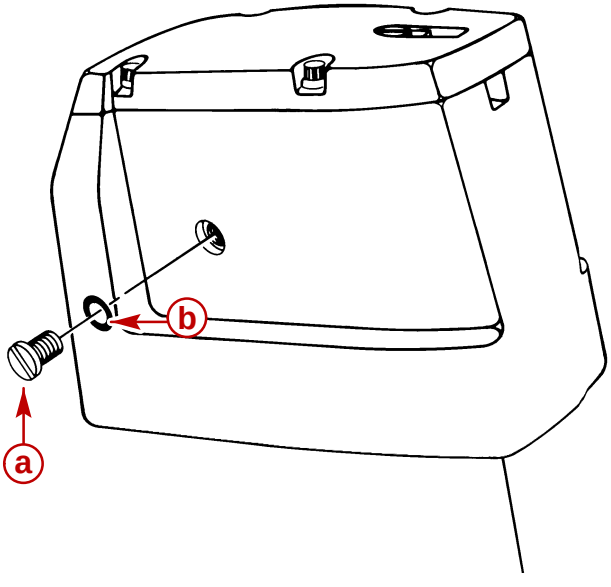
Drive Shaft Housing/Gear Housing

Separation

1. Clamp the unit on the gear case anti-ventilation plate in a suitable fixture.
2. Tilt the unit at a 45 degree angle, remove the oil fill/drain plug, then remove the drive shaft housing vent screw. Allow the drive unit to drain completely.

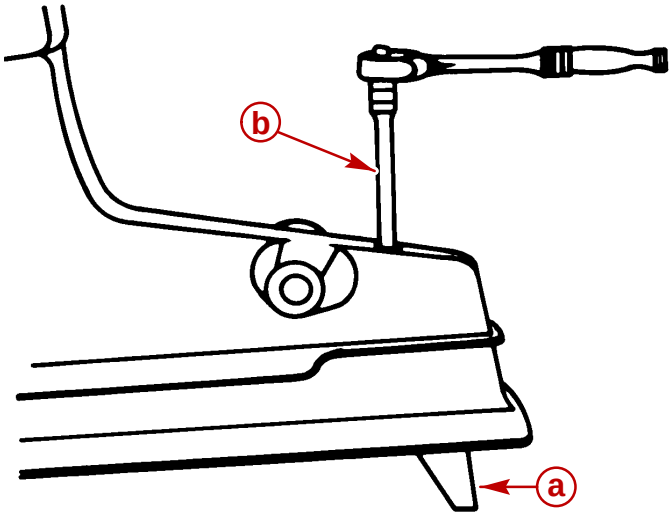


a - Fill/Drain Screw
b - Sealing Washer



a - Vent Screw
b - Sealing Washer

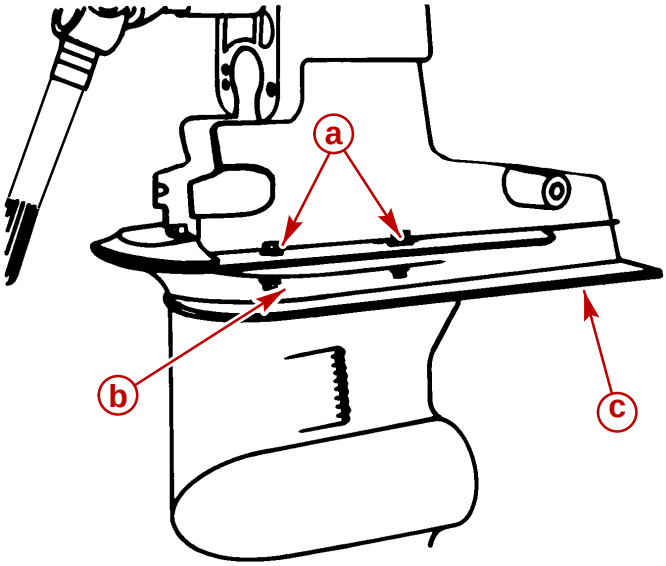
3. Mark the trim tab position with a piece of tape on the gear housing and remove the trim tab.



70116

a - Trim Tab
b - Extension With 1/2 In. Socket

4. Remove the bolts, nuts and washers from the port and starboard sides of the unit.
5. Remove the aft screw (in the trim tab well of the gear housing).
6. Remove the nut from the forward end of the unit.



70117

a - Nuts, Bolts and Washers
b - Nut
c - Screw

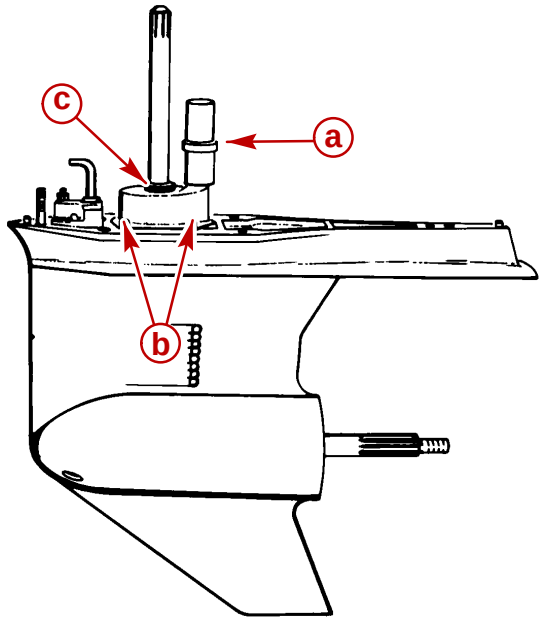
7. Lift the drive shaft housing straight off of the gear case and set aside.

Gear Housing and Component Disassembly

Water Pump Assembly

REMOVAL

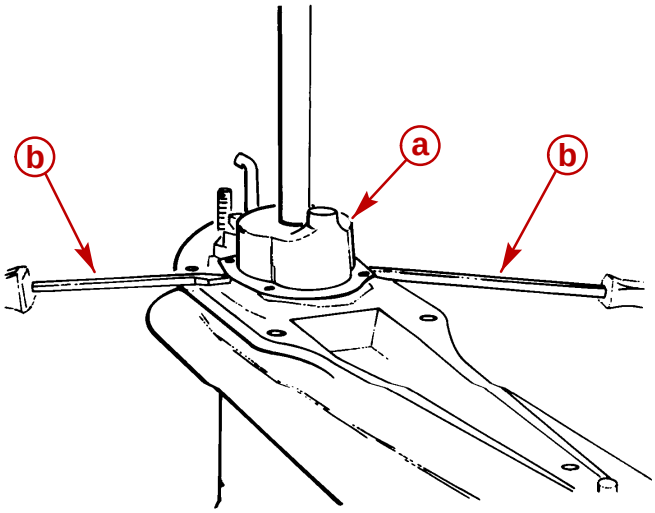
1. Remove the water face seal, water tube coupling assembly and the water pump screws.



70486

a - Water Tube Coupling Assembly
b - Water Pump Screws (4)
c - Water Face Seal

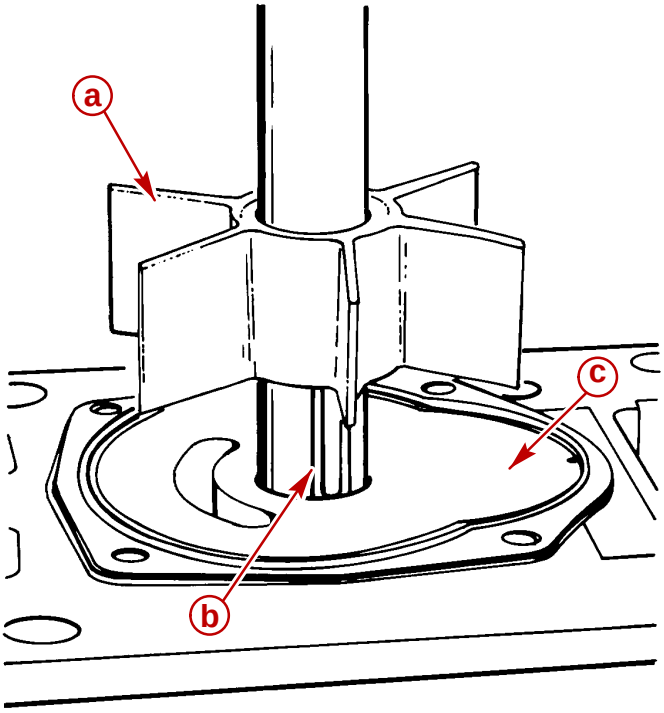
2. Carefully slide the water pump body straight up off of the drive shaft. It may be necessary to encourage the water pump body up by gently prying up on its mounting flanges with a couple of screwdrivers.



70487

a - Water Pump Body
b - Screwdrivers

3. Remove the impeller, impeller key, the face plate and gaskets. Discard the gaskets.

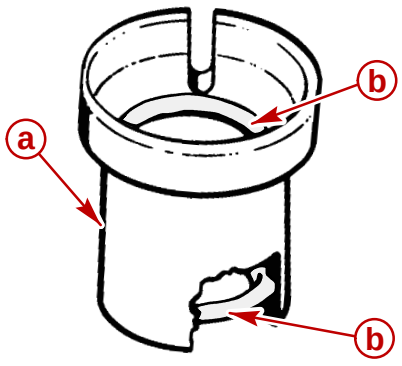


70605

a - Impeller
b - Impeller Key
c - Water Pump Face Plate And Gaskets (One Gasket On Each Side Of The Face Plate)

WATER PUMP INSPECTION

1. Inspect the water tube coupling assembly for wear or damage. If necessary replace the worn or damaged components especially the two O-ring seals on the inside, one at the top and one at the bottom.

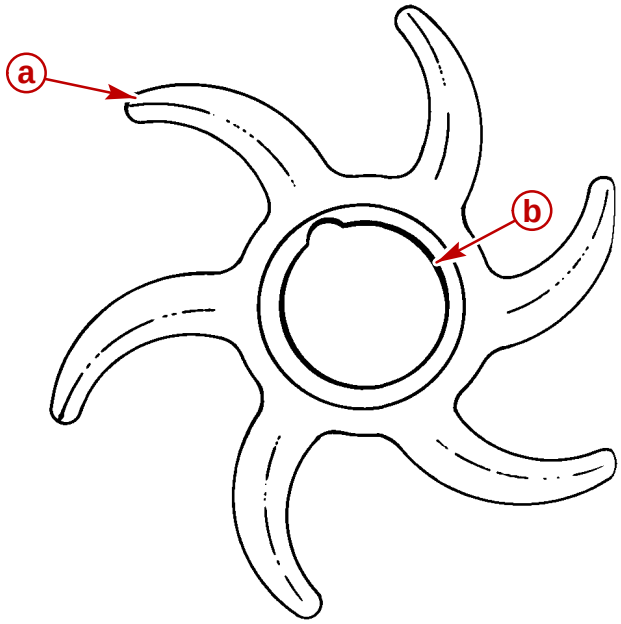


70613

a - Water Tube Adapter
b - O-ring Seals (2)

2. Inspect the water pump impeller for wear on the end, top and bottom of the impeller blades. Replace the impeller if this condition is found.

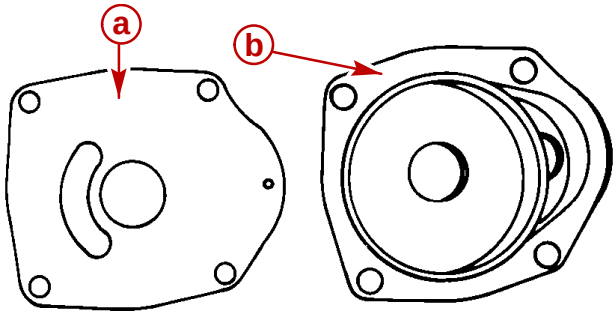
3. Inspect for proper bonding between the hub and the impeller. Replace the impeller if improper bonding is found.



70500

a - Impeller
b - Hub

4. Inspect the impeller blades to see if they are hardened or misshapened. Replace the impeller if the blades are in this condition.
5. Inspect the water pump face plate and the water pump interior for roughness and/or grooves. Replace the appropriate components if necessary.



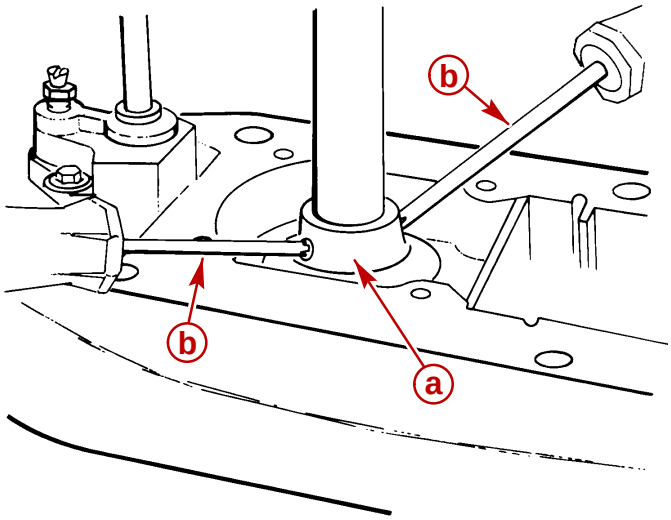
70609

a - Water Pump Face Plate
b - Water Pump Body

Oil Seal Carrier Assembly

REMOVAL

1. Remove the oil seal carrier from the gear housing. It may be necessary to gently pry up on it with two screwdrivers.



70489

a - Oil Seal Carrier
b - Screwdrivers

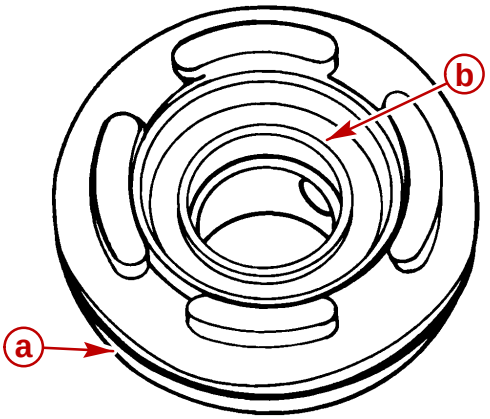
OIL SEAL CARRIER - INSPECTION

1. Inspect the oil seal carrier, O-ring and seals for wear and/or damage. If necessary replace defective parts as outlined following.

OIL SEAL CARRIER DISASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.*

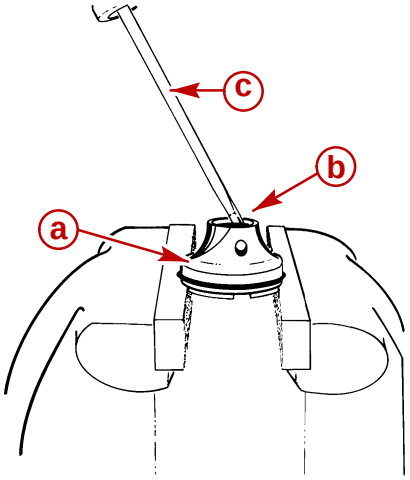
1. Remove the O-ring.



70501

a - O-ring
b - Oil Seals (2)

2. Remove the oil seals.



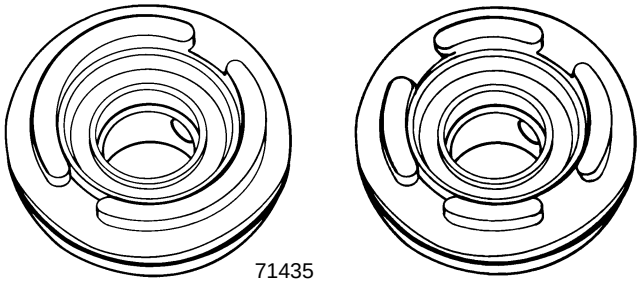
70610

a - Oil Seal Carrier
b - Oil Seals
c - Screwdriver

OIL SEAL CARRIER REASSEMBLY

The oil seal carrier may be a brown color (aluminum) material or a black glass filled nylon material. This black glass filled seal carrier will supersede the aluminum version. The new seal carrier can be identified by looking at the base. Where the old plastic carrier had only two support feet the new one will have four support feet. Also the seals in the old aluminum oil seal carrier are metal case and will require Loctite 27131 applied to the outside diameter prior to installation.

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*



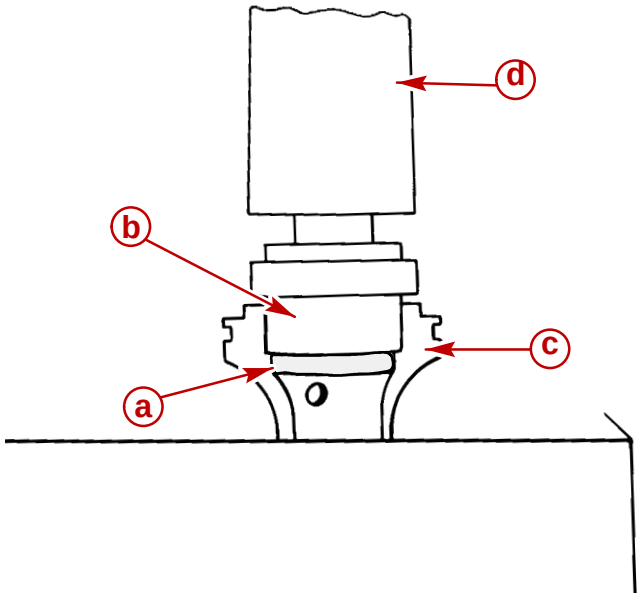
71435 70501

A. Old Style **B. New Style**

NOTE: *The earlier style oil seal carrier utilizes a large diameter and a small diameter oil seal. The later style uses the same oil seals as the drive shaft housing.*

1. Apply Quicksilver Perfect Seal sparingly to the oil seal bore prior to installing the oil seal into the oil seal carrier.
2. Assemble the small oil seal (with the lips of the oil seal facing away from the driver shoulder) onto the long end of the oil seal driver.

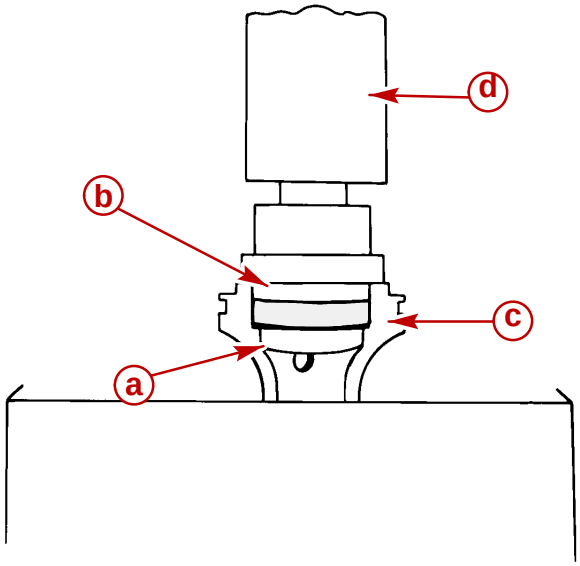
3. Press on the oil seal driver until the driver bottoms against the carrier. Do not press too hard as it could damage the oil seal carrier while driving the oil seal.



70611

a - First Oil Seal
b - Oil Seal Driver (91-817569) (Use Long End)
c - Oil Seal Carrier
d - Press

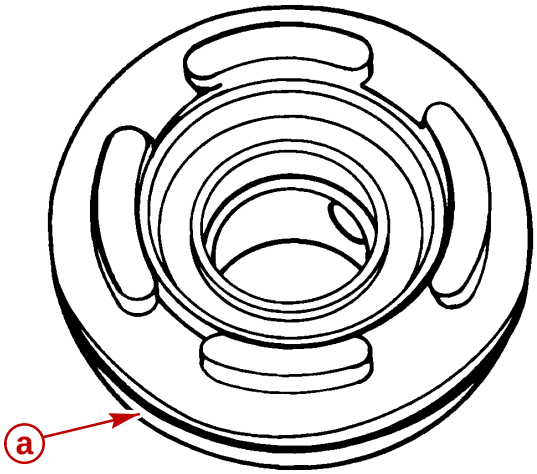
4. Assemble the second oil seal (with the lips of the oil seal facing the driver shoulder) onto the short end of the oil seal driver.
5. Press on the oil seal driver until the driver bottoms against the carrier. Do not press too hard as it could damage the oil seal carrier while driving the oil seal.



70612

a - Second Oil Seal
b - Oil Seal Driver (91-817569) Use Short End
c - Oil Seal Carrier
d - Press

6. Install the O-ring onto the oil seal carrier.



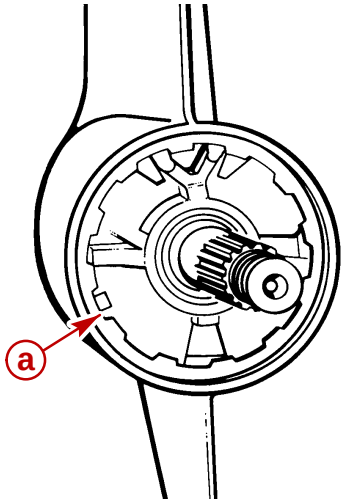
70501

a - O-ring

Bearing Carrier Assembly

REMOVAL

1. Straighten the tabs on the tab washer.

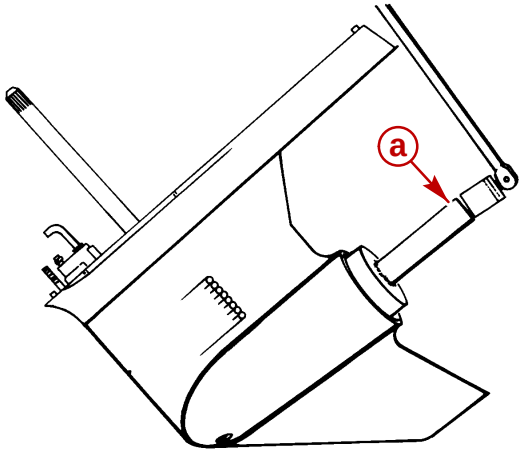


70490

a - Tab On Tab Washer

2. Remove the bearing carrier retainer following Step a or b as follows:

a. Remove the bearing carrier retainer using the Bearing Carrier Retainer Wrench.



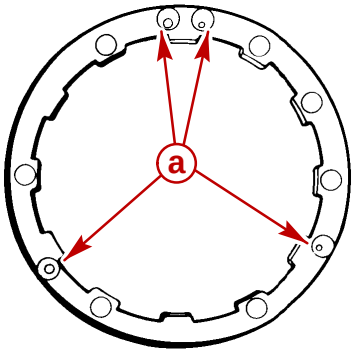
70491

a - Bearing Carrier Retainer Wrench (91-61069)

⚠ CAUTION

DO NOT drill into the gear housing retainer threads when using the following procedure for removing the retainer.

b. If the retainer is corroded in place, drill 4 holes in the retainer and fracture the retainer with a chisel. Pry the remaining segments out.

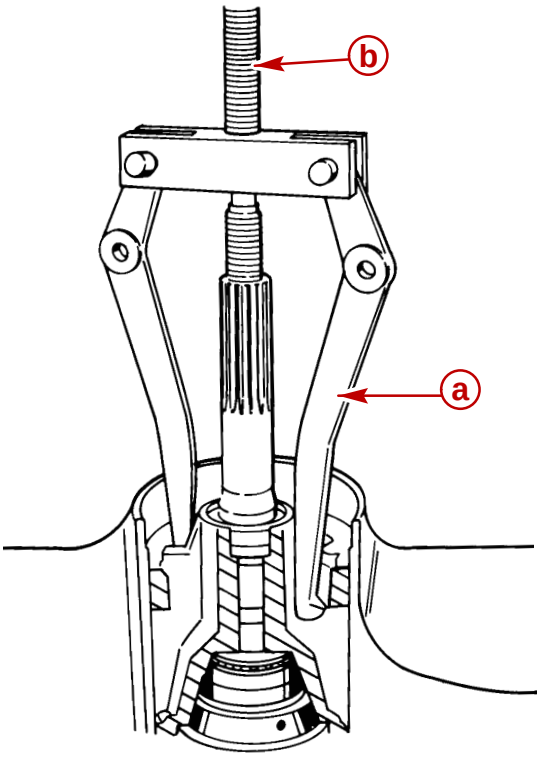


23356

a - Drilled Holes

3. Pull the bearing carrier from the gear housing by pulling on the outer ring of the bearing carrier.

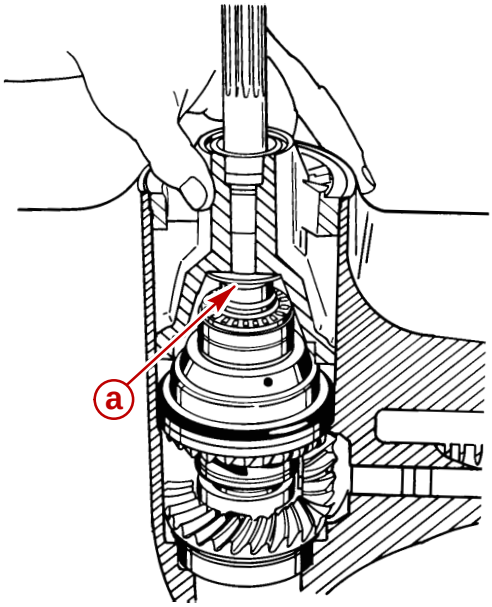
NOTE: *If the bearing carrier is seized in the gear housing, it may be necessary to use heat to loosen the carrier.*



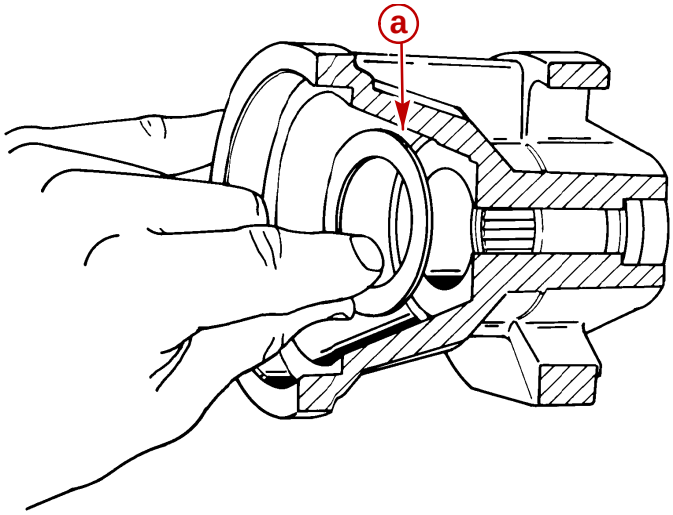
50786

a - Puller Jaws (91-46086 A1)
b - Puller Bolt (91-85716)

4. Lift the bearing carrier out of the gear housing. Locate and retain the thrust washer that may be stuck to the inside surface of the bearing carrier.



50826



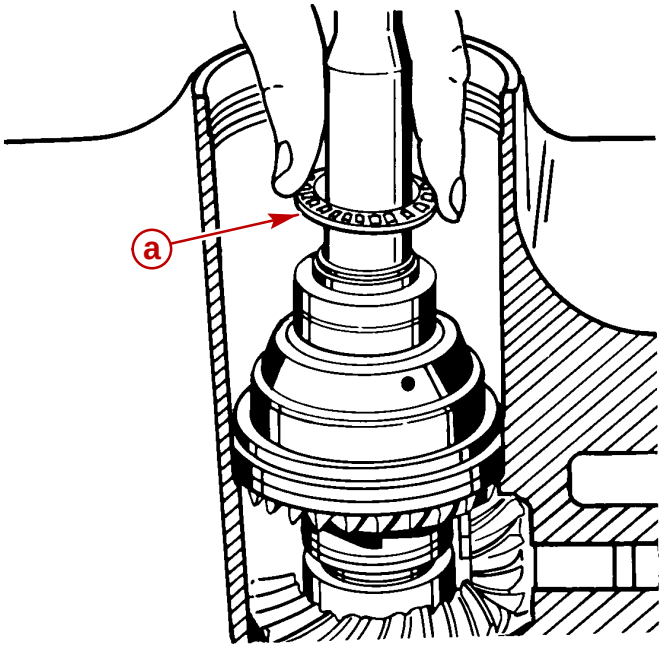
50779

a - Thrust Washer

Forward Gear Bearing and Adaptor

REMOVAL

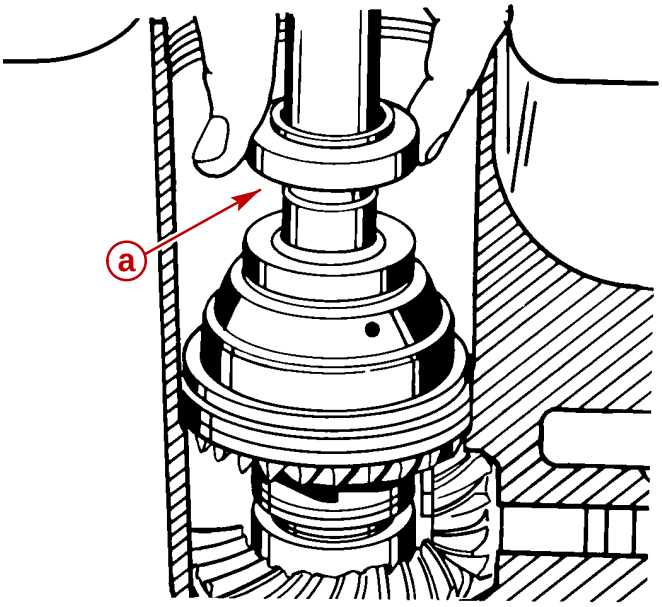
1. Remove the aft thrust bearing.



50786

a - Thrust Bearing

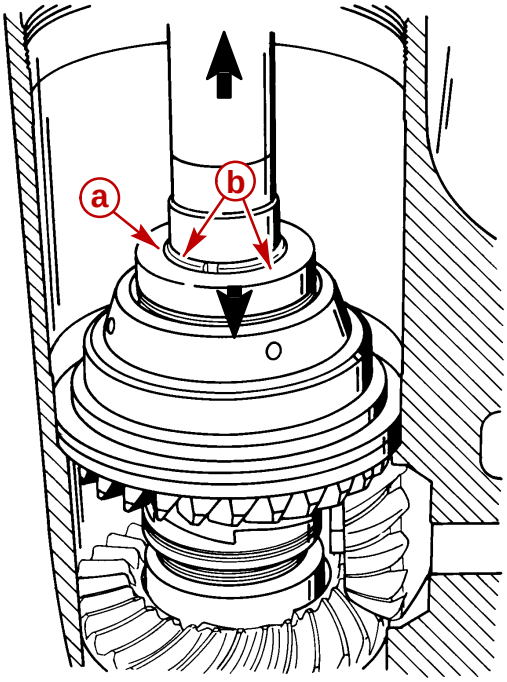
2. Remove the aft thrust collar.



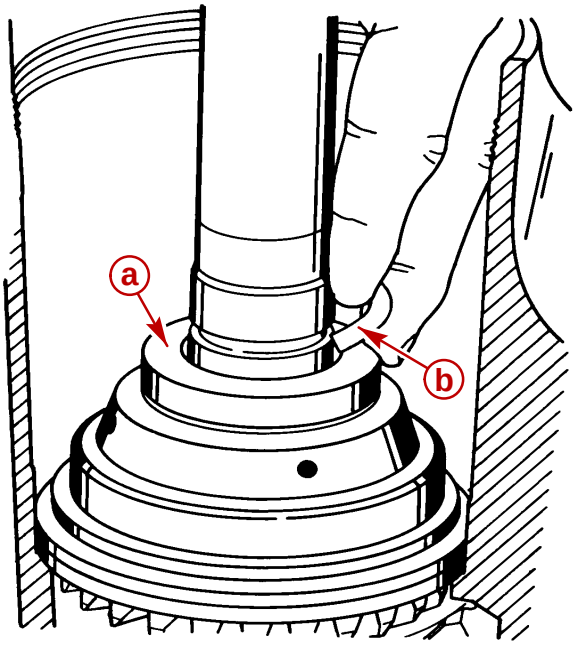
50787

a - Thrust Collar

3. Lift up on the propeller shaft and push down on the forward thrust collar to remove the two keepers.



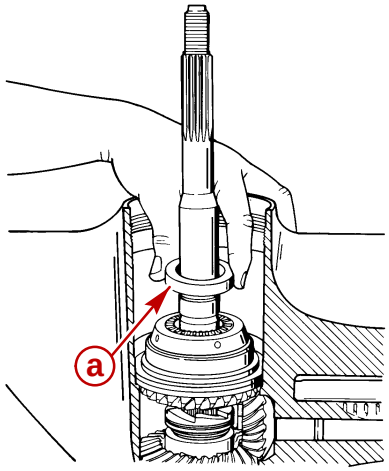
50778



50826

a - Thrust Collar
b - Keepers (2)

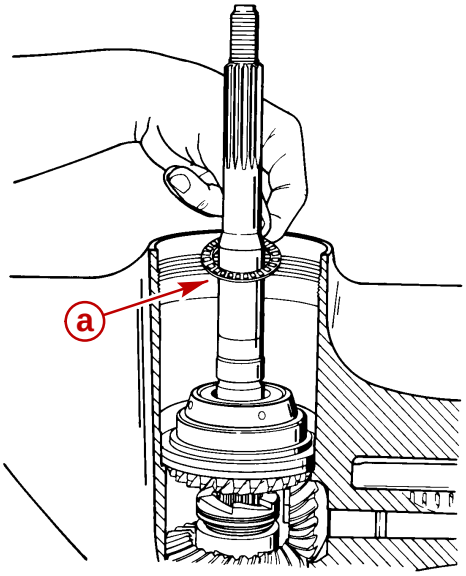
4. Remove the forward thrust collar.



50784

a - Thrust Collar

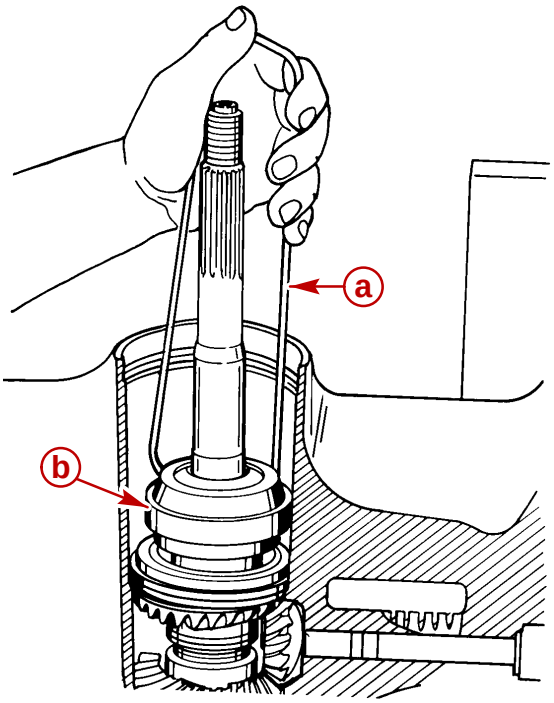
5. Remove the forward thrust bearing.



50783

a - Thrust Bearing

6. Form a tool using a 1/8 in. (3 mm) wire as shown in the following figure and remove the forward gear bearing adaptor.



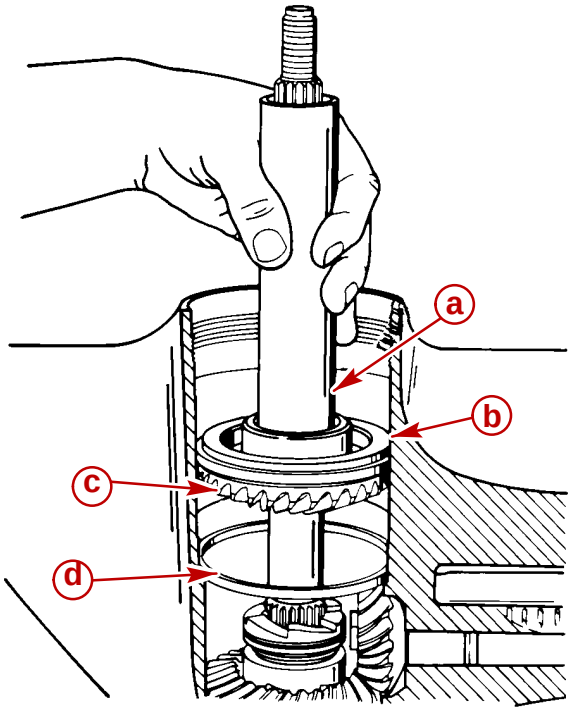
50786

a - Wire Tool
b - Forward Gear Bearing Tool

NOTE: *The thrust race that must be removed in the following step has a tight fit in the gear housing bore. Use the Forward Gear Installation Tool (91-815850) to attempt to remove the thrust race and the forward gear together. If this attempt fails, form a small hook on the end of a stiff piece of wire and try to pull the thrust race out of the gear housing. Remove O-ring prior to removal of thrust race.*

7. Being careful not to damage it, remove the O-ring from inside the gear housing.
8. Remove the forward gear, thrust race and the thrust bearing (between the gear and the race).

9. Remove the forward gear shim.



50783

a - Forward Gear Installation Tool (91-815850)
b - Thrust Race
c - Forward Gear
d - Shim

COMPONENT - INSPECTION

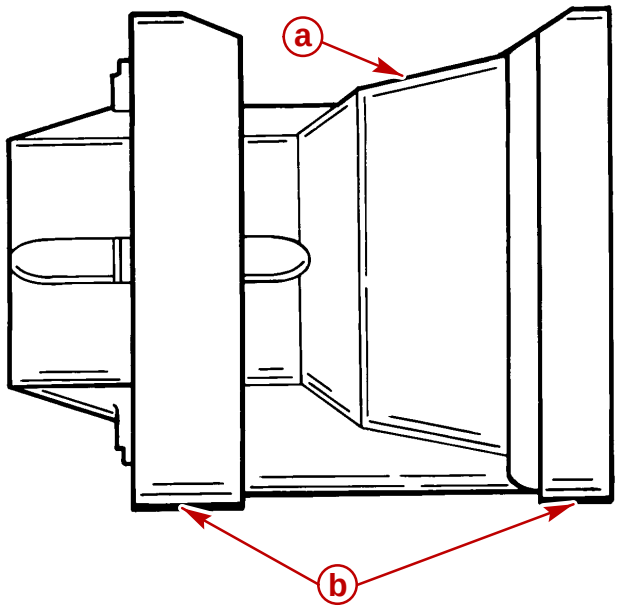
⚠ CAUTION

Eye protection must be worn when performing next procedure. Failure to do so may cause personal injury.

1. Clean the assembly and all components with a suitable solvent and dry the parts thoroughly using compressed air.

NOTE: *If any of the following items are found to be defective, complete the appropriate instruction(s).*

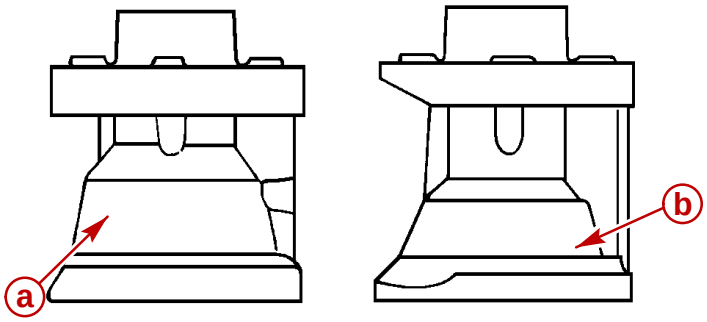
2. Inspect the bearing carrier for signs of excessive corrosion especially in the area where the bearing carrier touches the gear housing. If excessive corrosion is evident, replace the carrier.



50818

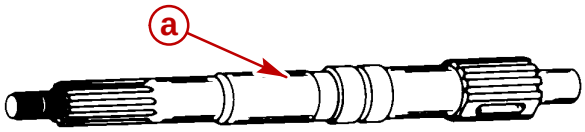
a - Bearing Carrier
b - Mating Surfaces

NOTE: *The bearing carrier has changed slightly. The later style bearing carrier is about 1/8 of an inch taller and more streamlined than the earlier style. See “Special Information” on page 3C-8.*



a - Earlier Style Bearing Carrier (Prior To S/N OF680000)
b - Later Style Bearing Carrier (S/N OF680000 And Above)

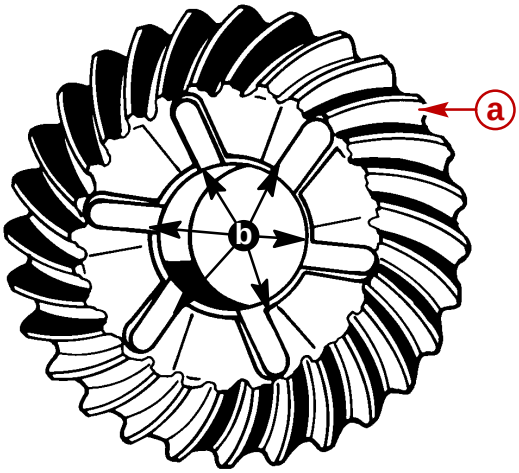
3. The condition of the bearing surface on the propeller shaft in the area that the needle bearing (in the bearing carrier) rides is an indication of the condition of the needle bearing in the bearing carrier. Replace the bearing if the surface of the shaft is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded metal particles.



50698

a - Propeller Shaft Bearing Contact Area

4. Inspect the forward gear for pitted, chipped, broken teeth, hairline fractures and excessive or uneven wear. Replace the forward gear and the pinion gear if any defects are found.
5. Inspect the outer hub of the forward gear for excessive wear or damage. Replace the forward and the pinion gear if either of these conditions exist.
6. Inspect the clutch jaws of the gear for damage. Surfaces must not be chipped or rounded off. Replace the forward and the pinion gear if any damage is found.

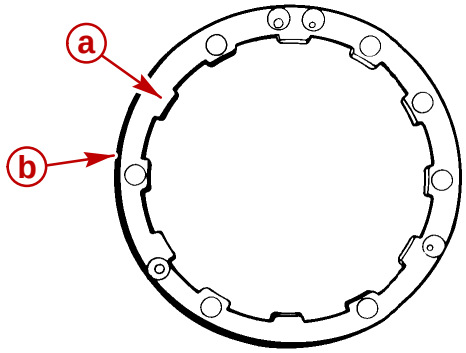


23355

a - Gear Teeth
b - Clutch Jaws

7. Inspect the thrust bearings, collars and forward gear bearing adaptor for excessive wear in the areas where the thrust bearings come into contact with them. Replace the appropriate components if they are found to be defective.

8. Inspect the bearing carrier retainer for cracks and/or broken or corroded threads. Replace it if any are found.



23356

a - Drilled Holes

9. Inspect the large O-ring for damage and/or deterioration. Replace it if either condition is found.

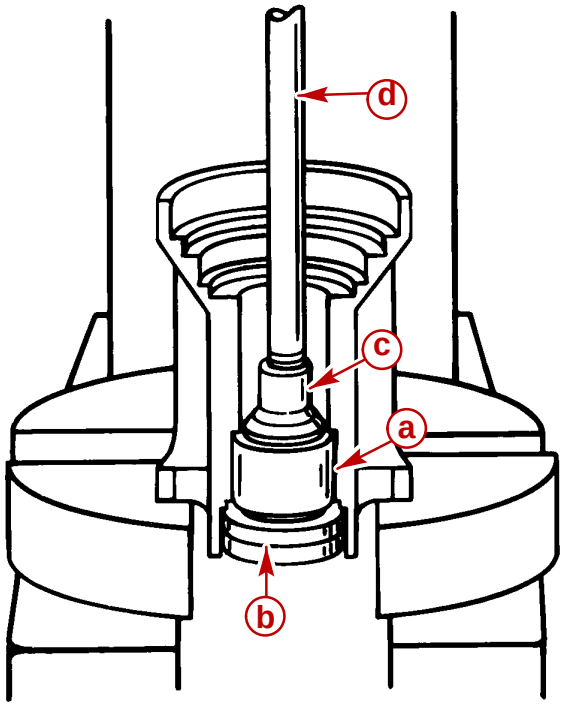
Bearing Carrier Disassembly And Inspection

NOTE: *Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.*

NOTE: *Inspection of the bearing surfaces on the propeller shaft where the needles of the bearing carrier needle bearing rolls, gives an indication of the condition of the needle bearing inside the bearing carrier. Replace needle bearing in the bearing carrier if the prop shaft is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded particles.*

1. Perform the following Step “a” or “b” as necessary.

   a. **If Replacing The Needle Bearing And Seals:** Remove the needle bearing and seals with the tools as shown.

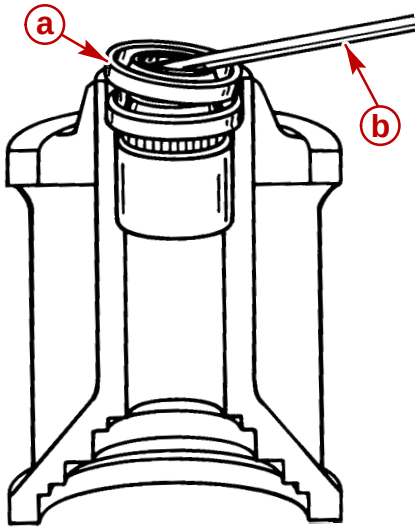


23140

a - Needle Bearing
b - Oil Seals
c - Driver Head (91-36569)
d - Bearing Driver Rod (91-37323)

(1.) **Discard the needle bearing and both seals.**

b. **If Replacing The Seal Only:** Remove the oil seals with a suitable pry bar, being careful not to damage the bore of the bearing carrier.



23140

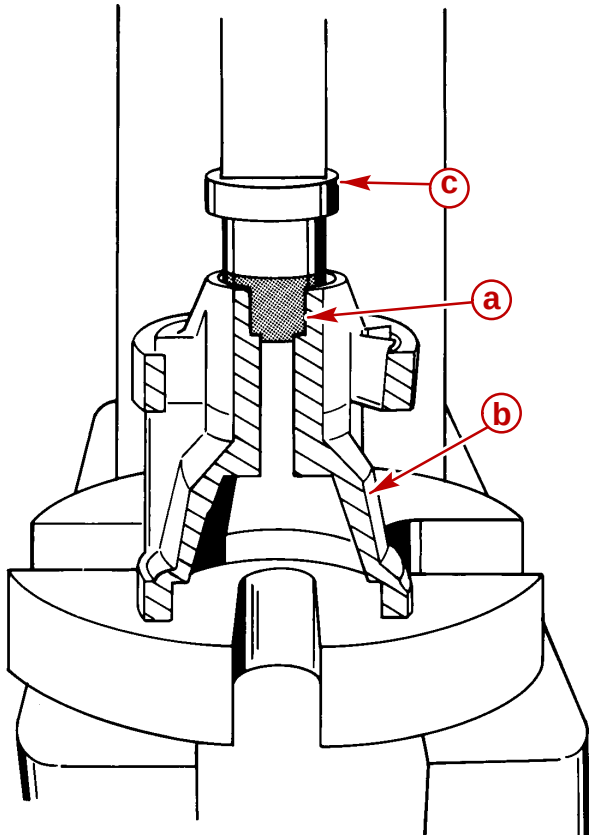
a - Oil Seals
b - Pry Bar

(1.) **Discard both of the seals.**

Bearing Carrier Reassembly

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

1. Clean all of the components with a suitable solvent and dry the parts thoroughly using compressed air. Be careful not to spin the bearing.
2. Lightly lubricate the bore that the needle bearing is pressed into with 2-4-C Marine Lubricant with Teflon. Make sure that none of the lubricant gets onto the seal bore. If it does, make sure that it is **thoroughly cleaned off** after the needle bearing is installed in the next step.
3. Press the needle bearing into the bearing carrier until the driver contacts the bearing carrier. Ensure that the numbered side of the needle bearing faces the seal end (aft end) of the carrier.

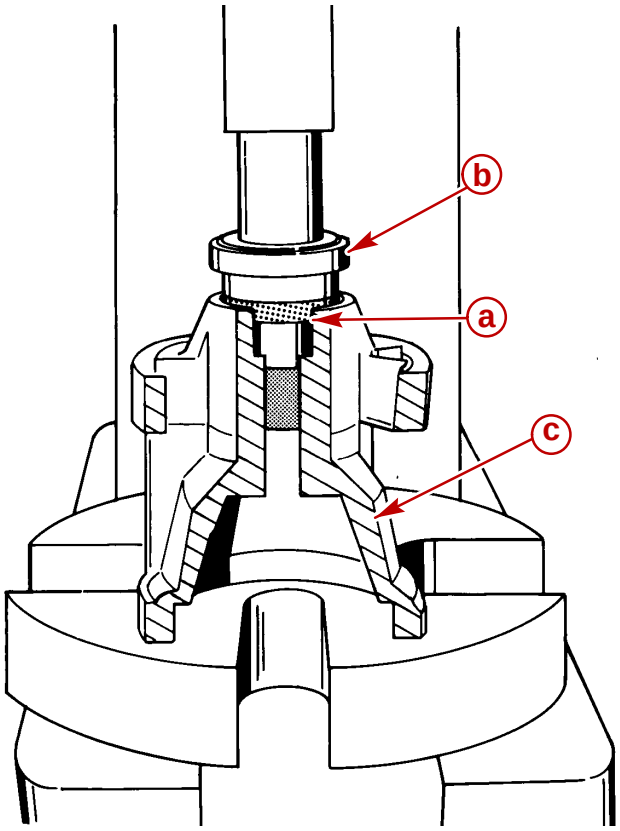


50788

a - Needle Bearing
b - Bearing Carrier
c - Needle Bearing Driver (91-15755)

4. **Thoroughly clean** then apply a thin film of Loctite 27131 (92-809820) to the bore in which the first seal is to be pressed.
5. Assemble the first seal (with the lips of the seal facing away from the driver shoulder) onto the long end of the oil seal driver.

6. Press on the oil seal driver until the driver bottoms onto the aft face of the bearing carrier.

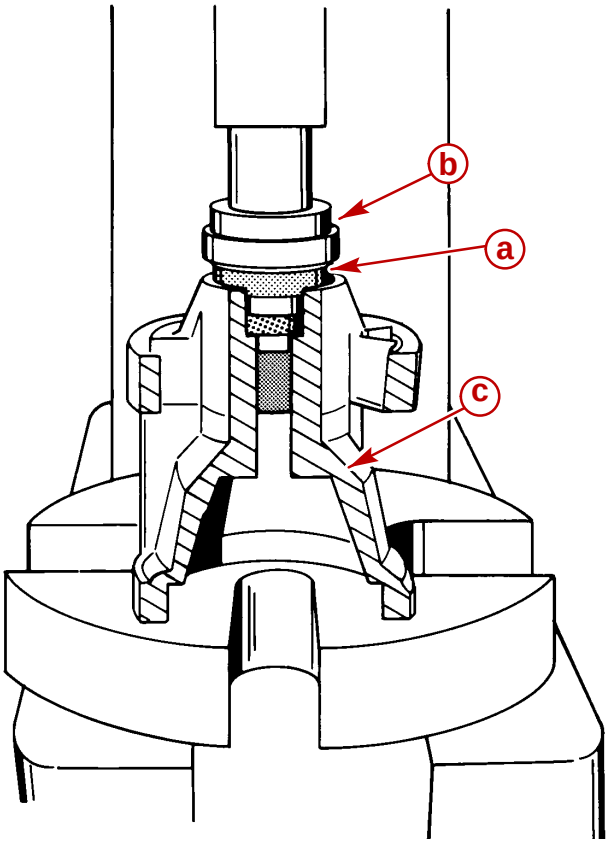


50788

a - Oil Seal
b - Oil Seal Driver (91-31108) (Long End)
c - Bearing Carrier

7. Apply a thin film of Loctite 271 to the bore in which the second seal is to be pressed.
8. Assemble the second seal (with the seal lips facing the driver shoulder) onto the short end of the driver.

9. Press the oil seal with the driver until the driver contacts the bearing carrier.



50788

a - Driver (Short End)
b - Oil Seal (Lips Toward Driver Shoulder)
c - Bearing Carrier

10. Wipe up all of the excess Loctite. Do not allow any of the excess Loctite to spread to other parts of the assembly.

Forward Gear Bearing Adaptor Assembly

INSPECTION

1. Thoroughly clean the forward gear bearing adaptor with a suitable solvent and dry it thoroughly using compressed air.

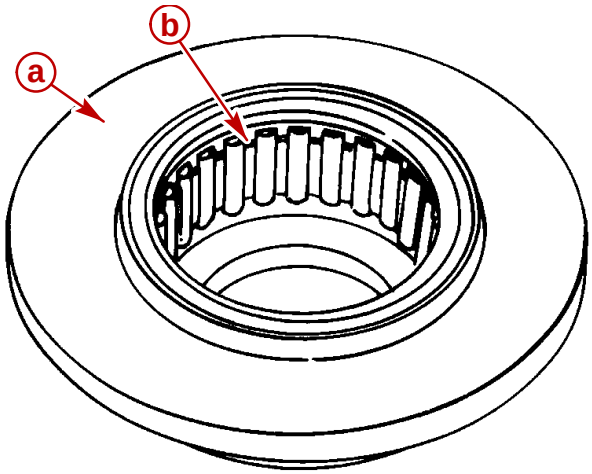
NOTE: *The condition of the bearing surfaces on the forward gear in the areas that the bearings of the bearing adaptor and the thrust bearing rides is an indication of the condition of the respective bearings. Replace the bearing(s) if the surface of the gear and/or the thrust washer is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded metal particles.*

2. Assemble the forward gear to the bearing adaptor. Inspect them for excessive movement or roughness by rotating the gear in the adaptor. Replace the bearing in the adaptor if either of these conditions exist.

3. Inspect the adaptor for other signs of excessive wear or damage. Replace the adaptor if any are found.

NOTE: The later model *forward gear bearing adapter comes with the needle bearing pressed into the adapter. For future reference, the needle bearing in side the bearing*

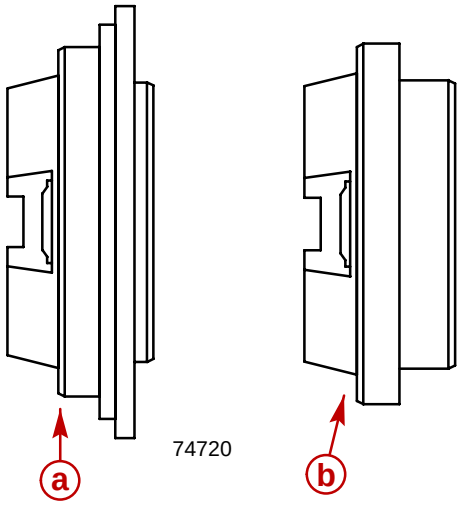
adapter does not require a special driver. The needle bearing is pressed into the adapter until the bearing is flush with the edge of the adapter bore.



74888

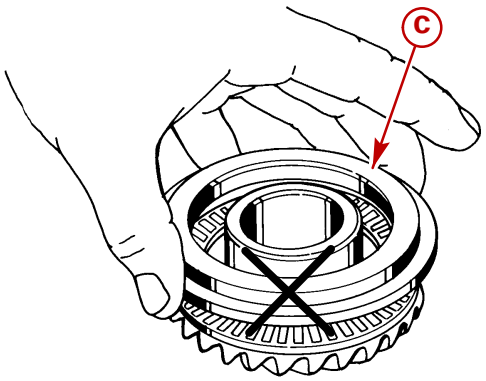
a - Forward Gear Bearing Adapter
b - Needle Bearing

NOTE: *A difference exists in the forward gear bearing adaptor. The latest style adaptor has incorporated the earlier thrust race into the adaptor. Refer to the following illustration for identification.*



74720

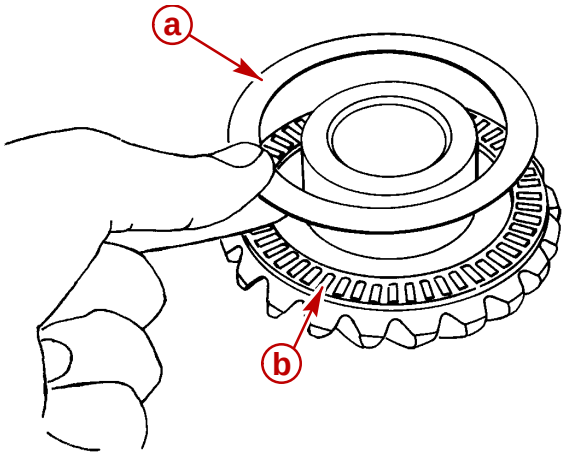
74721



50785

a - Bearing Adaptor - Latest Style
b - Bearing Adaptor - Earlier Style
c - Thrust Race - No Longer Separate

NOTE: *The latest style adapter will use a thrust washer (included in this gear set) to ride against the adaptor face.*



74886

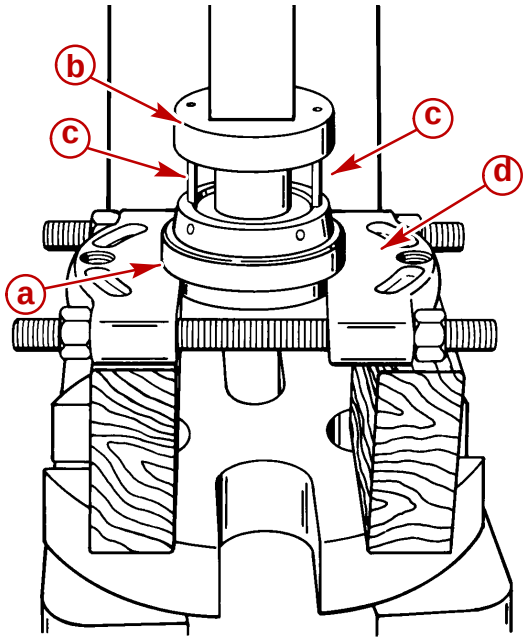
a - Thrust Washer
b - Thrust Bearing

DISASSEMBLY

NOTE: *Complete the instructions in this section only if the needle bearing in the bearing adaptor is defective and the adaptor is to be reused.*

1. Remove the bearing from the adaptor using the bearing removal tool. Align the pins of the tool with the holes of the adaptor and apply pressure to the center of the tool so that the pressure is equal on both of the pins. **Discard the bearing.**

NOTE: *The universal puller plate should rest on the press with the threaded rods on the supports. The plate is turned in the illustration for visual clarity.*



50874

a - Forward Gear Bearing Adaptor
b - Bearing Removal Tool (91-816245)
c - Pins
d - Universal Puller Plate

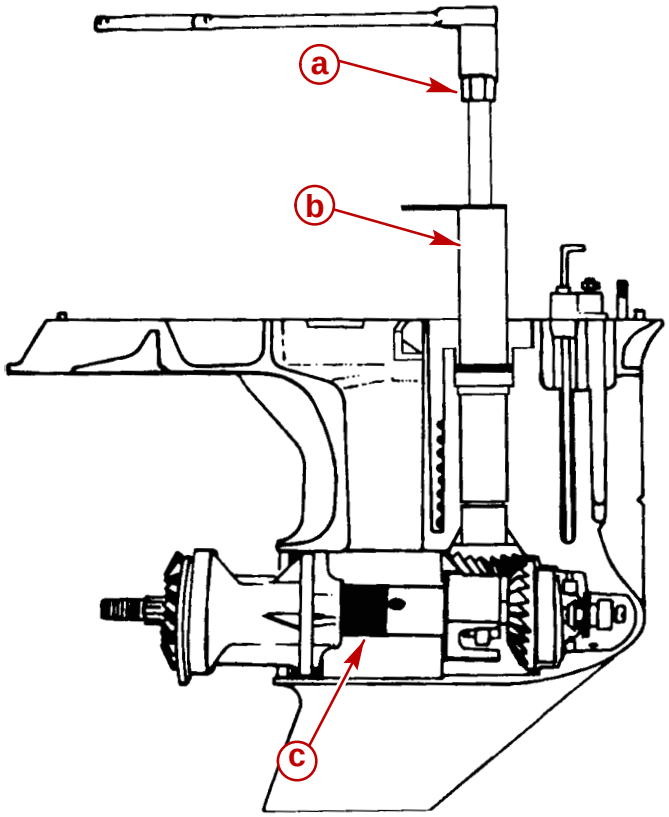
REASSEMBLY

1. Lubricate the bore that the needle bearing is pressed into with Quicksilver Special Lubricant 101.
2. **If earlier style**, assemble the needle bearing to the adaptor with the numbered end of the bearing facing the driver shoulder.
3. **If earlier style**, press the needle bearing into the bearing adaptor using a suitable mandrel until the bearing bottoms in the adaptor.

Drive Shaft Assembly

REMOVAL

1. Remove the drive shaft pinion nut as follows:
   a. Place the drive shaft bearing retainer wrench onto the drive shaft. Do not loosen the retainer at this time.
   b. Insert the pinion nut adaptor with the MR slot facing the pinion gear, into the gear housing as shown. It may be necessary to slightly lift and rotate the drive shaft to align the pinion gear nut into the pinion nut adapter slot.
   c. Install the bearing carrier into the gear housing backwards to support the prop shaft and to keep the pinion nut adapter aligned.
   d. Place the drive shaft nut wrench over the drive shaft splines and **loosen**, (but do not fully unscrew), the pinion nut by rotating the drive shaft counterclockwise.



70887

a - Drive Shaft Nut Wrench (91-56775)
b - Drive Shaft Bearing Retainer Wrench (91-43506)
c - Pinion Nut Adaptor (91-61067 A1)

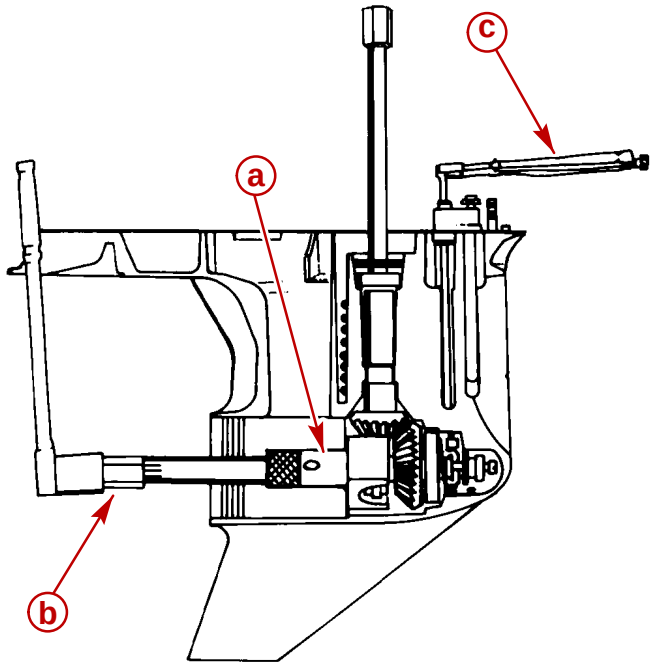
e. Completely unscrew the drive shaft bearing retainer.

f. Completely unscrew the pinion nut by rotating the drive shaft (or the propeller shaft) in a counterclockwise direction.

g. Remove the bearing carrier and all tools.

h. **If the drive shaft is broken,** place propeller shaft nut wrench onto the propeller shaft splines, hold shift shaft in reverse gear and **loosen**, (but do not fully unscrew), the pinion nut by rotating prop shaft counterclockwise to turn gears, thus loosening the pinion nut.

NOTE: *The propeller shaft nut wrench is included with the pinion nut adaptor kit.*

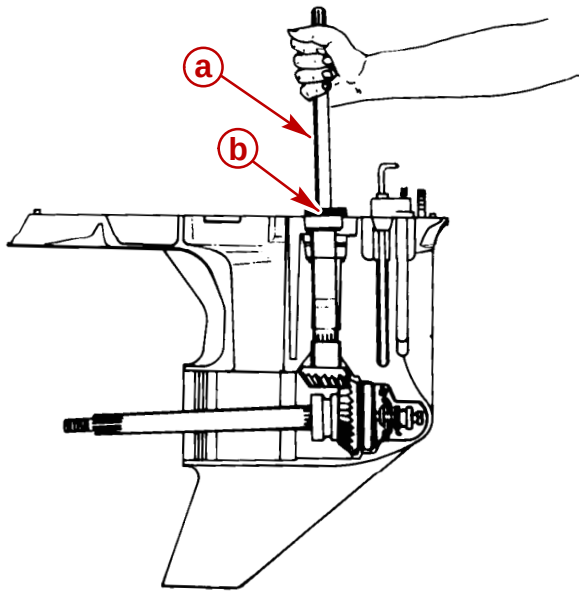


70607

a - Pinion Nut Adaptor (91-61067 A3)
b - Propeller Shaft Nut Wrench (91-61077)
c - Shift Shaft (Turn Clockwise)

IMPORTANT: The pinion bearing rollers are free to fall out of the pinion bearing once the drive shaft is removed. Be careful not to lose the (18) rollers.

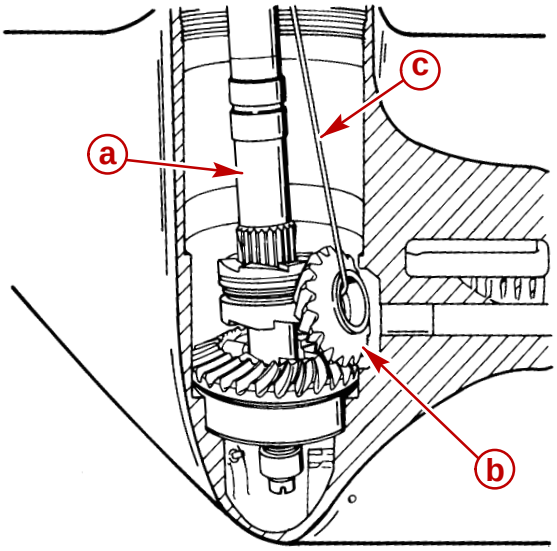
2. Remove the drive shaft and all components by pulling the drive shaft straight out of the gear housing as shown.



70608

a - Drive Shaft
b - Drive Shaft Retainer, Bearing Cup Bearing And Shims

3. Retrieve the pinion gear by lifting up the propeller shaft to partially disengage the shaft from the gear enough to tilt the propeller shaft downward (away from the pinion gear).
4. Form a small hook on a stiff piece of wire and attempt to hook onto the top side of the gear and pull it out. It may be necessary to slightly move the propeller shaft from side-to-side to dislodge the pinion gear.



50884

a - Propeller Shaft
b - Pinion Gear
c - Wire Tool

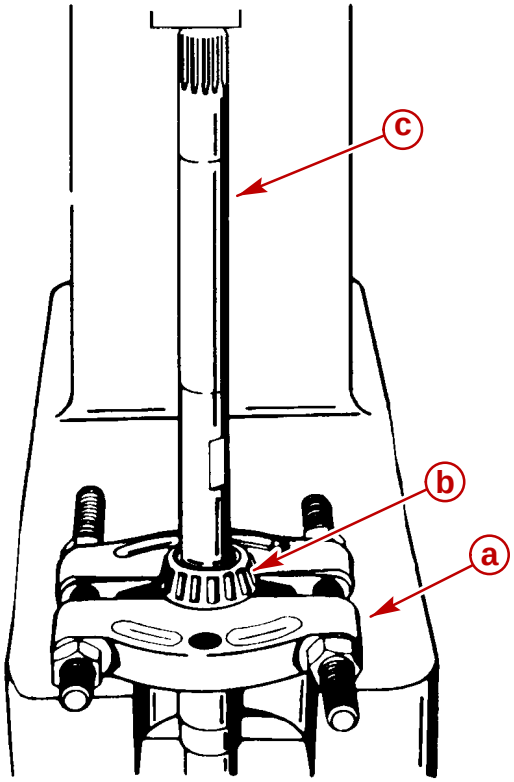
DRIVE SHAFT INSPECTION

1. Clean all parts with a suitable solvent and dry the parts thoroughly using compressed air, being careful not to spin the bearings.
2. The condition of the drive shaft bearing cup is an indication of the condition of the tapered roller bearing on the drive shaft. Replace the bearing and bearing cup if the cup is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded particles.
3. Inspect the bearing surface on the drive shaft where the needles of the lower pinion bearing roll. Replace the drive shaft if it is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded particles.
4. Inspect the splines at both ends of the drive shaft for a worn or twisted condition. Replace the drive shaft if either condition exists.
5. Inspect the gear for pitting, chipped or broken teeth, hairline fractures and excessive or uneven wear. **Replace the pinion gear and the forward gear** if any defects are found.

DRIVE SHAFT DISASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been found to be defective and are in need of repair or replacement.*

1. Press the tapered roller bearing from the drive shaft using the universal puller plate to support the **inner race** of the bearing while removing it.



70699

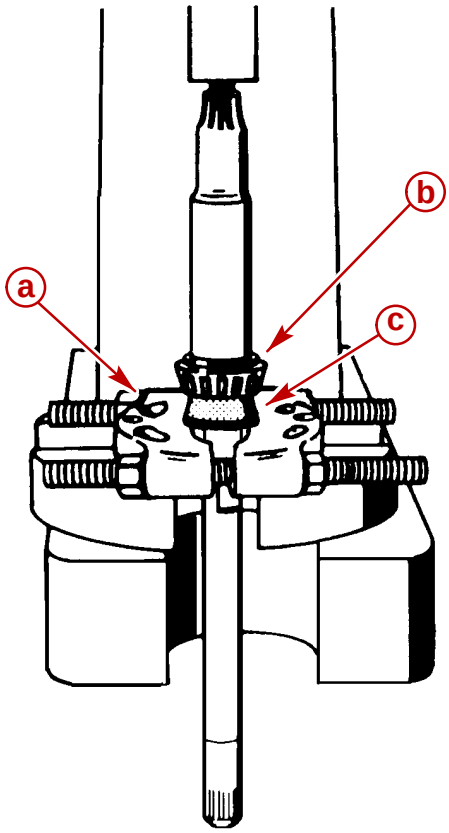
a - Universal Puller Plate (91-37241)
b - Tapered Roller Bearing
c - Drive Shaft

DRIVE SHAFT REASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

1. Assemble a new tapered roller bearing to the drive shaft with the large O.D. of the bearing facing the pinion gear end of the drive shaft.
2. Press the tapered roller bearing onto the drive shaft using the universal puller plate and a suitable mandrel, (an old tapered roller bearing inner race).

NOTE: *The universal puller plate should rest on the press with the threaded rods on the supports. The plate is turned in the illustration for visual clarity.*



70700

a - Universal Puller Plate (91-37241)
b - Tapered Poller Bearing
c - Suitable Mandrel

Propeller Shaft Assembly

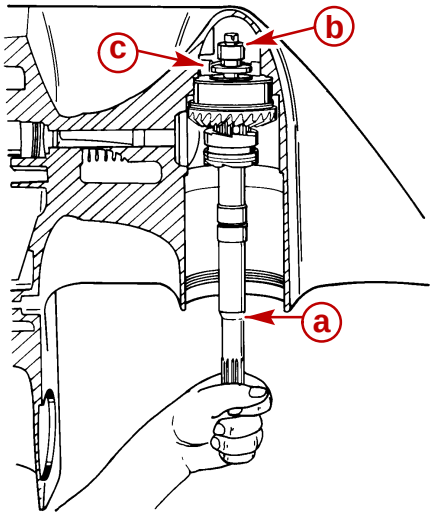
REMOVAL

⚠ CAUTION

Hold onto the propeller shaft assembly in the following step to avoid personal injury and/or dropping components when turning the gear housing over.

1. While holding onto the propeller shaft, turn the gear housing over so that the bore opening is facing down.
2. While moving the propeller shaft to the left (port) side of the gear housing, to allow the shift spool to disengage from the shift crank, lower the propeller shaft out of the gear housing.

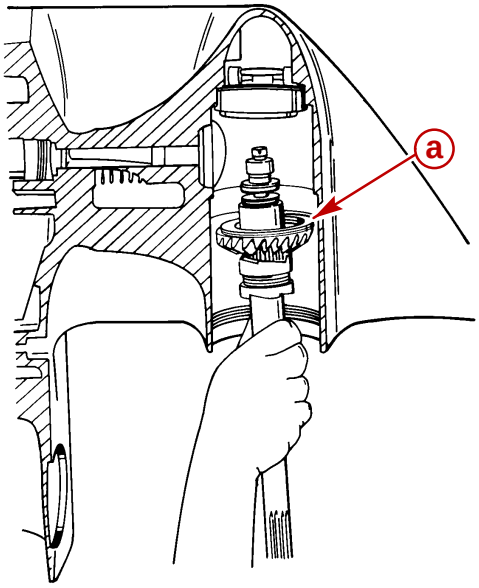
NOTE: *The rollers of the reverse gear bearing adaptor may become dislodged while removing the propeller shaft assembly. If this occurs, inspect the bearing cage to see if it has been damaged. If it has not been damaged simply snap the rollers back into position. If it has been damaged, it will be necessary to remove and replace the bearing.*



50887

a - Propeller Shaft Assembly
b - Shift Spool
c - Shift Crank

3. Locate and retain the thrust race and thrust bearing which could be on top of the reverse gear (if not, they may be stuck to the reverse gear bearing adaptor).



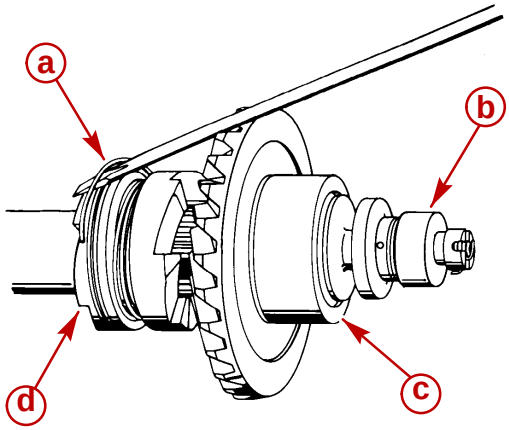
50887

a - Thrust Bearing And Race

PROPELLER SHAFT DISASSEMBLY

IMPORTANT: When accomplishing the next step all of the parts are free to come apart. Work closely over a work bench to ensure that the parts are not dropped or damaged and to avoid personal injury.

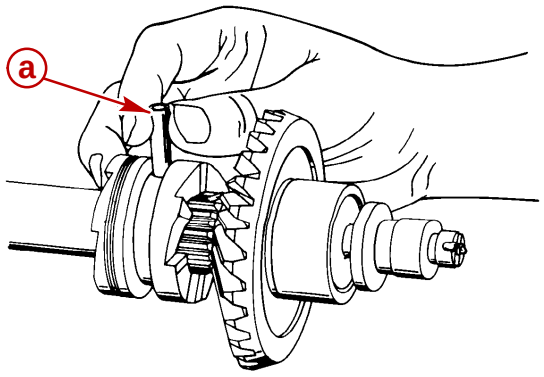
1. Remove the spring around the clutch being careful not to stretch it during removal. If the spring does not coil back to its normal position once it has been removed it must be replaced.



50885

a - Spring
b - Shift Spool Assembly
c - Reverse Gear Assembly
d - Sliding Clutch

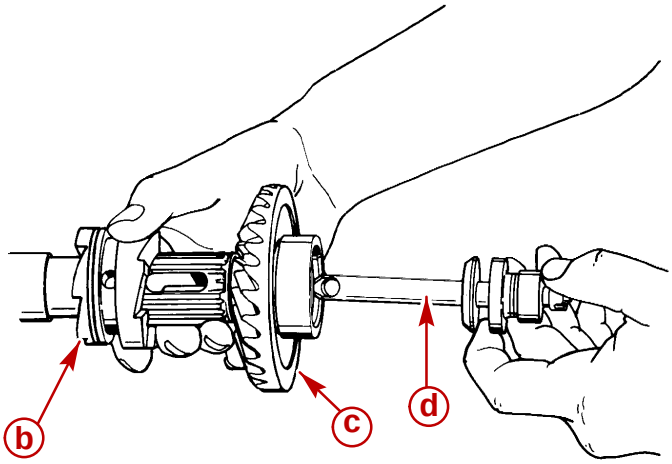
2. Remove the cross pin that goes through the clutch.



50885

a - Cross Pin

3. Slide the spool assembly out of the propeller shaft, remove the reverse gear and slide the clutch off of the propeller shaft.

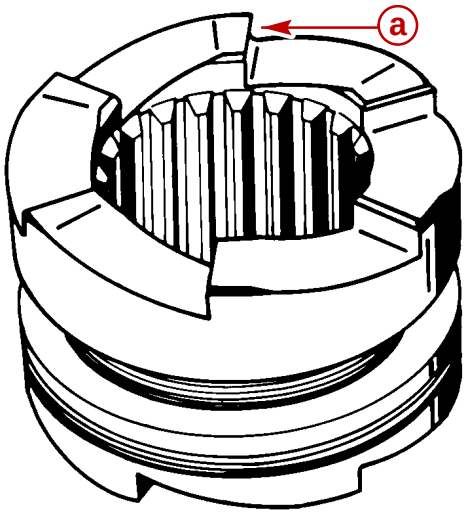


50881

a - Cross Pin
b - Clutch
c - Reverse Gear Assembly
d - Spool

PROPELLER SHAFT INSPECTION

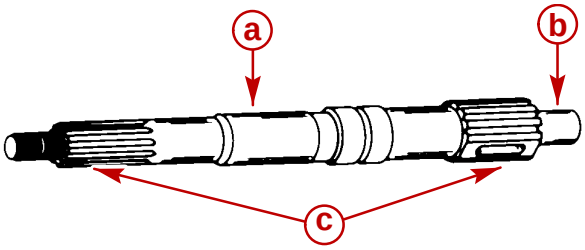
1. Clean all the parts with a suitable solvent and dry the parts thoroughly using compressed air. Be careful not to spin bearings.
2. Inspect the sliding clutch jaws for damage. Jaws must not be chipped or rounded off. Replace the clutch if they are.



23350

a - Sliding Clutch Jaws

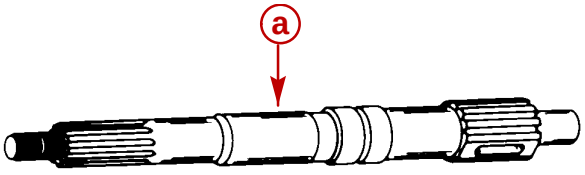
3. Inspect the bearing surfaces on the propeller shaft where the needles of the bearing carrier needle bearing and the needles of the reverse gear needle bearing roll. Replace the propeller shaft if it is pitted, grooved, scored, worn unevenly, discolored form overheating or has embedded particles.



50698

a - Bearing Carrier Needle Bearing Contact Area
b - Reverse Gear Needle Bearing Contact Area
c - Splines

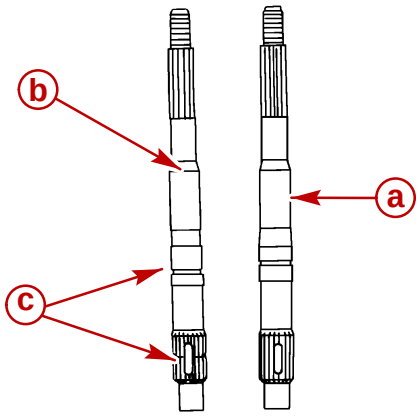
4. Inspect the propeller shaft splines at both ends for a broken, worn or twisted condition. Replace the propeller shaft if any of these conditions exists.
5. Inspect the surface of the propeller shaft where the bearing carrier seal lips contact the shaft. If the oil seals have made grooves, the propeller shaft must be replaced.



50698

a - Bearing Carrier Seal Contact Area

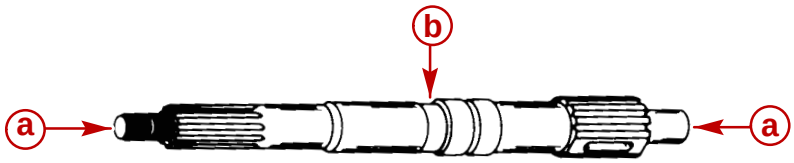
NOTE: *The later style propeller shaft has a groove on the shaft where the clutch slides onto the shaft. The keeper slot is also moved toward the forward end of the shaft.*



75223

a - Earlier Style Propeller Shaft (Prior To S/N OF680000)
b - Later Style Propeller Shaft (S/N OF680000 And Above)
c - Keeper Slot and Spline Groove (S/N OF680000 And Above)

6. Inspect the propeller shaft for a bent condition. Use either one of the following methods.
   a. **Method 1 - V-Blocks and Dial Indicator**
      (1.) Position the propeller shaft bearing surfaces on V-blocks.
      (2.) Adjust the height of V-blocks to level the propeller shaft.
      (3.) Position the dial indicator tip just forward of the propeller shaft splines.
   b. **Method 2 - Lathe and Dial Indicator**
      (1.) Mount the propeller shaft between the centers of a lathe or other appropriate device.
      (2.) Position the dial indicator tip just forward of the propeller shaft splines.



23355

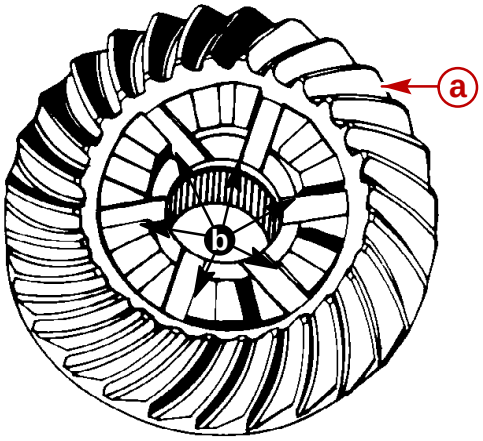
a - Propeller Shaft Centers
b - Dial Indicator (91-58222 A1) Check Movement Here

7. Rotate the propeller shaft and observe the dial indicator movement. If the indicator in the dial moves more than .005 in. (.013 mm), replace the propeller shaft.

Reverse Gear Assembly

INSPECTION

1. Clean the reverse gear assembly with a suitable solvent and dry thoroughly with compressed air. Be careful not to spin the bearings.
2. Inspect the gear for pitting, chipped or broken teeth, hairline fractures and excessive or uneven wear. **Replace the reverse gear** if any defects are found.
3. Inspect the clutch jaws of the gear for damage. The surfaces must not be chipped or rounded off. **Replace the reverse gear** if any of these conditions exist.

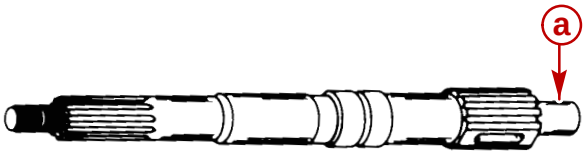


23351

a - Reverse Gear Teeth
b - Clutch Jaws

NOTE: *The needle bearing in the reverse gear should not be removed unless damage has been found. Inspect to ensure that all of the needles are present and in position. The needles may have become dislodged while removing the gear from the propeller shaft (and/or while removing the propeller shaft assembly from the gear housing). They may be snapped back into place as long as no damage has occurred to the bearing cage.*

4. Inspect the needle bearings on the inside of the reverse gear and the bearing surface on the propeller shaft. If either the needle bearings or the bearing surface of the propeller shaft is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded particles, replace the propeller shaft and remove and replace the needle bearing in the reverse gear.



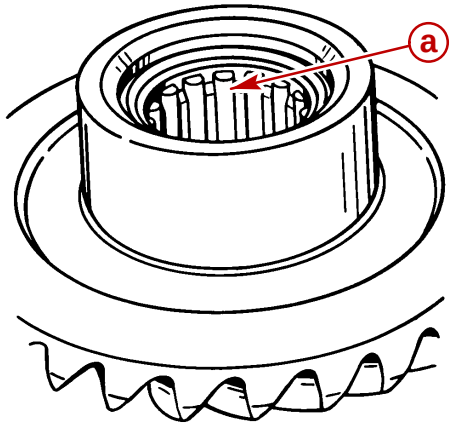
50698

a - Forward Gear Needle Bearing Contact Area

REVERSE GEAR DISASSEMBLY

NOTE: *Complete the instructions in this section only if the needle bearing in the gear has been found to be defective and the reverse gear is to be reused. Bearings that have become dislodged may be snapped back into position. If this is the only problem that exists it is not necessary to replace the needle bearing.*

1. Press the reverse gear needle bearing out using a suitable mandrel.



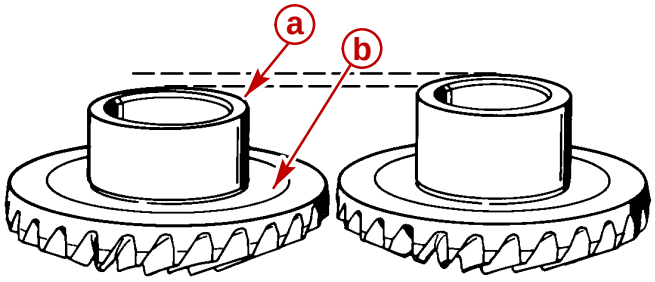
50778

a - Reverse Gear Needle Bearing

REVERSE GEAR REASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

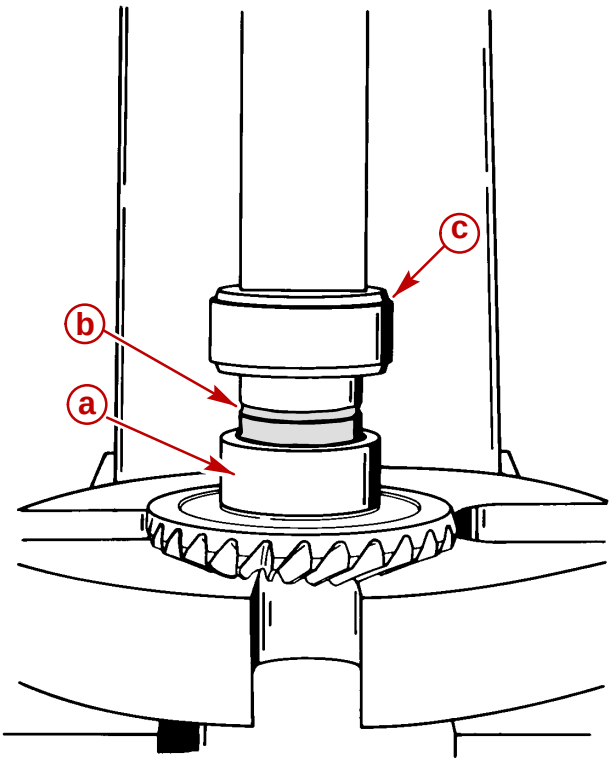
IMPORTANT: The appearance of the forward and reverse gear is almost identical. There are two ways to distinguish between the reverse and forward gears. The reverse gear has a shorter hub and it has a groove cut into the back of the gear just inside the thrust bearing race.



REVERSE **FORWARD** 50885

a - Shorter Hub
b - Groove

1. Press the needle bearing into the reverse gear using bearing driver as shown.



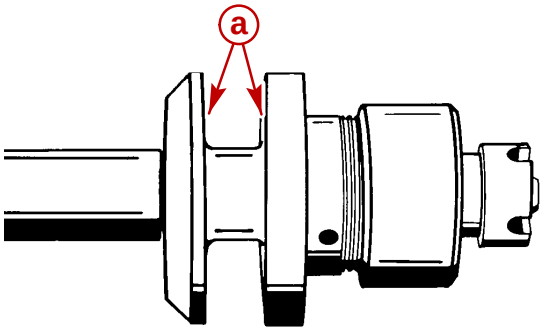
50789

a - Reverse Gear
b - Needle Bearing
c - Bearing Driver (91-816244)

Shift Spool Assembly

INSPECTION

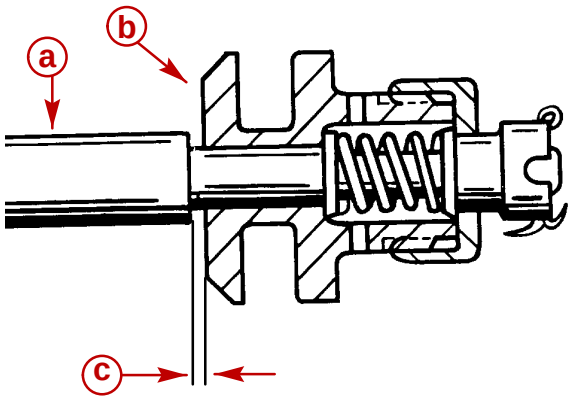
1. Clean the assembly with a suitable solvent and dry the parts thoroughly using compressed air.
2. Inspect the shift spool assembly for damage. Small nicks and burrs may be smoothed. If any parts are damaged or worn beyond repair, it will be necessary to replace the complete shift spool assembly. Individual parts are not available for the assembly.
3. Inspect the shift spool for wear in the area where the shift crank comes into contact.



23356

a - Contact Area

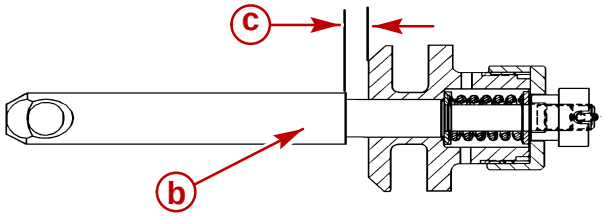
4. Ensure that the spool spins freely (it may be helpful to lightly tap the forward [castle nut] end of the shift spool shaft against a firm surface to align the internal parts).
5. Ensure that the spool has no more than .002-.010 (0.051-0.254 mm) end play.
6. To check end play:
   a. Push in on the shift spool. Take measurement.
   b. Pull out on the shift spool. Take measurement.
   c. The difference between the two measurements is the end play.



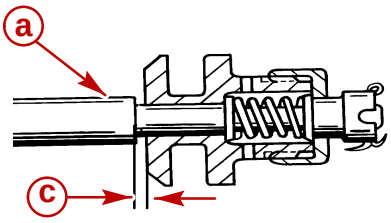
74877

a - Shift Shaft
b - Spool
c - End Play Measurement:

NOTE: *The later style shift spool assembly for the counter rotation has a larger gap than the earlier style. This later style shift spool, beginning with serial number OF726586, is sold as a whole assembly and must be used when replacing the earlier style (Prior to S/N OF726586).*



74877



75219

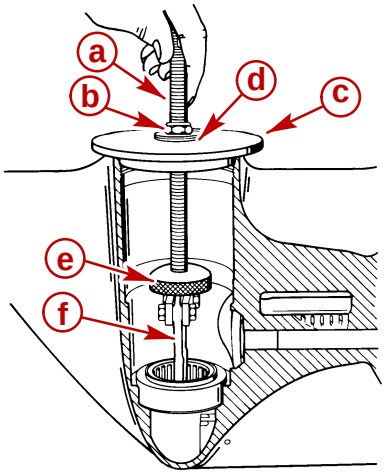
a - Earlier Style Shift Spool Assembly (Prior To S/N OF726586)
b - Later Style Shift Spool Assembly (S/N OF726586 And Above)
c - Measure End Play Here At Gap

Reverse Gear Bearing Adaptor Assembly

REMOVAL

IMPORTANT: Do not catch the shift crank pin with the jaws.

1. Remove the reverse gear bearing adaptor using the tools as shown in the next figure. Remove, measure and make note of the shim thickness and **discard (do not reuse) the shims.**



50780

a - Puller Shaft (91-31229)
b - Nut (11-24156)
c - Guide Plate (91-816243)
d - Washer (91-34961)
e - Puller Head (From Slide Hammer Puller Kit (91-34569 A1)
f - Jaws (91-816242)

1. Thoroughly clean the reverse gear bearing adaptor with a suitable solvent and dry it thoroughly using compressed air.

NOTE: *The condition of the bearing surfaces on the reverse gear, in the areas that the bearings of the bearing adaptor and the thrust bearing rides, is an indication of the condition of the respective bearings. Replace the bearing(s) if the surface of the gear and/or the thrust washer is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded metal particles.*

2. Assemble the reverse gear, the thrust bearing and the thrust race to the bearing adaptor. Inspect them for excessive movement or roughness by rotating the gear in the adaptor. Replace the bearing in the adaptor and/or the thrust bearing if either of these conditions exist.

3. Inspect the adaptor for other signs of excessive wear or damage. Replace the adaptor if any are found.

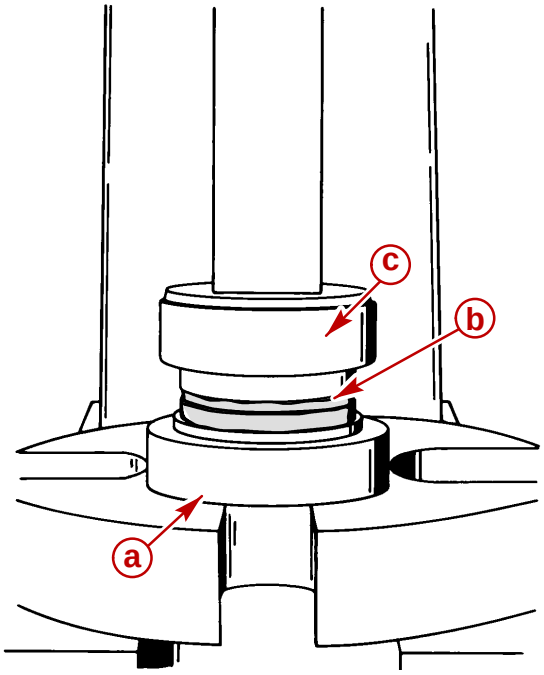
DISASSEMBLY

NOTE: *Complete the instructions in this section only if the needle bearing in the bearing adaptor is defective and the adaptor is to be reused.*

1. Remove the bearing from the adaptor using a suitable mandrel.
2. **Discard the bearing.**

REASSEMBLY

3. Lubricate the bore that the needle bearing is to be pressed into with Quicksilver Special Lubricant 101 (92-13872A1).
4. Position the needle bearing on the adaptor with the numbered end of the bearing facing the driver shoulder.
5. Press the needle bearing into the bearing adaptor using a suitable mandrel until the bearing is flush with the face of the adaptor.



50790

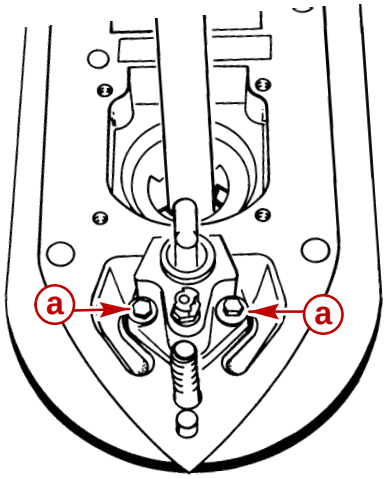
a - Reverse Gear Bearing Adaptor
b - Suitable Mandrel
c - Bearing

Shift Shaft Assembly

REMOVAL

NOTE: *It is possible to remove and service the shift shaft assembly (but not the shift crank inside the gear case) without removing any of the internal components of the gear housing.*

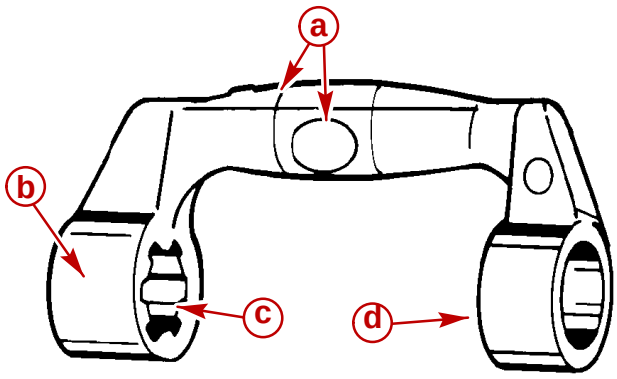
1. Remove the shift shaft bushing screws and remove the shift shaft by pulling it straight out of gear housing.



70494

a - Shift Shaft Bushing Screws

2. Remove the shift crank from the inside of the gear housing. Clean it with a suitable solvent and dry it thoroughly. Inspect it for wear in the areas that contact the shift spool and inspect the splines and the diameter that goes over the locating pin for damage or excessive wear.

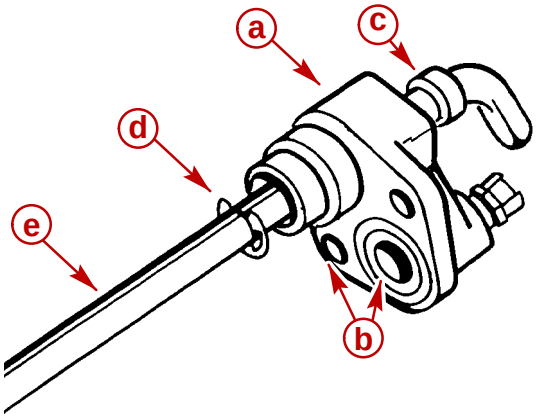


23350

a - Contact Area
b - Shift Crank
c - Splines
d - Diameter For Locating Pin

SHIFT SHAFT DISASSEMBLY

1. Remove the clip and slide the bushing assembly off of the straight end of the shift shaft. Remove the rubber sleeve from the shaft.



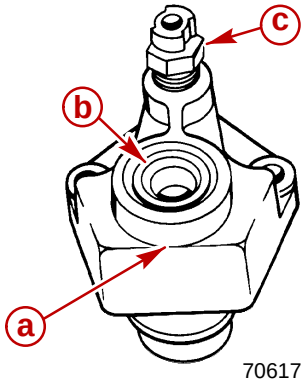
70616

a - Shift Shaft Bushing
b - O-rings (2)
c - Sleeve
d - Clip
e - Shift Shaft

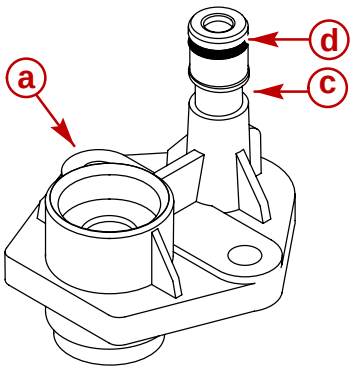
CLEANING AND INSPECTION

1. Clean all components with a suitable solvent and dry thoroughly with compressed air.
2. Inspect the shift shaft bushing for cracking, damage or excessive wear.
3. Inspect the seal inside the bushing, the sleeve and the O-rings on the outside of the bushing for damage or excessive wear.
4. Inspect the speedometer connector for damage or blockage.

If any of these conditions exist replace the appropriate components. Note that the bushing and seal are available only as an assembly.



70617

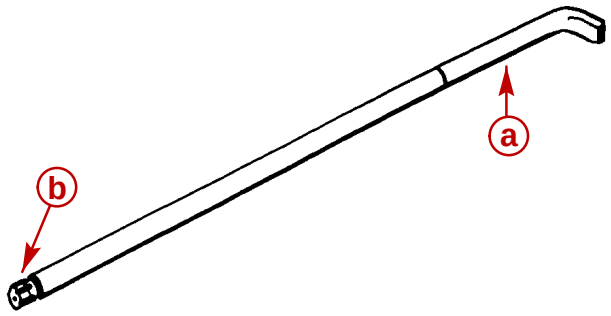


75670

Earlier and Later Models Shown

a - Shift Shaft Bushing
b - Seal
c - Speedometer Tube Connector
d - O-ring

5. Inspect the shift shaft splines and seal surface for corrosion and/or excessive wear. Check fo a bent condition. Replace the shift shaft if either if these conditions are found.



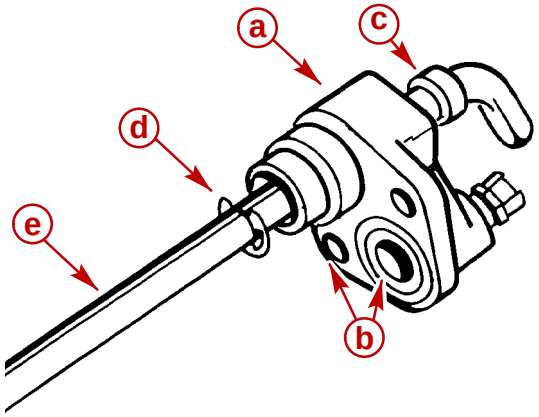
70618

a - Seal Surface
b -

SHIFT SHAFT REASSEMBLY

NOTE: *Complete the instructions in this section only if the assembly components have been disassembled and repaired or replaced.*

1. Lightly lubricate the seats of the O-ring diameters on the bushing and the lip of the oil seal with Quicksilver 2-4-C Marine Lubricant with Teflon.
2. If the speedometer connector was removed and/or replaced, lightly coat the **threads of the connector** with Quicksilver Perfect Seal. Assemble the speedometer connector to the bushing and torque the connector to 4.5 lb-in. (0.51 Nm).
3. Assemble all components as shown below.



70616

a - Shift Shaft Bushing
b - O-rings (2)
c - Sleeve
d - Clip
e - Shift Shaft

Pinion Bearing

REMOVAL

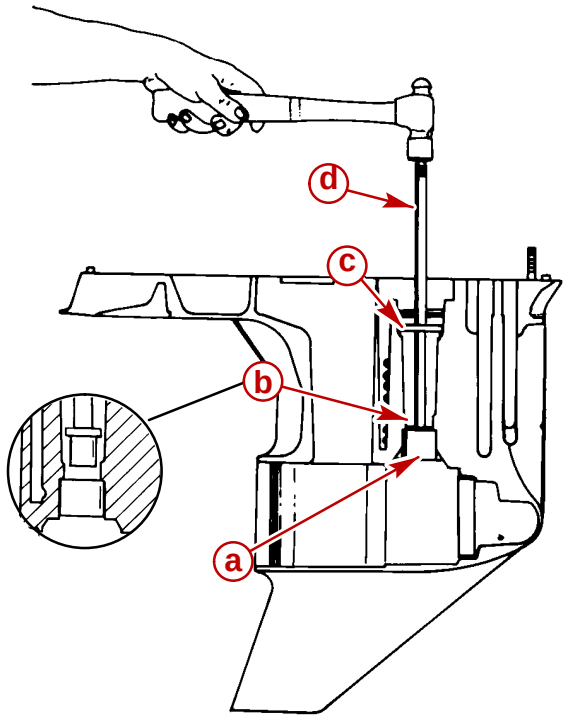
NOTE: *Inspect the bearing surface on the drive shaft where the needles of the lower pinion bearing roll. The condition of the drive shaft at this location gives an indication of the*

condition of the needle bearing. Replace lower pinion bearing (needles and race as a set) if the drive shaft is pitted, grooved, scored, worn unevenly, discolored from overheating or has embedded particles.

IMPORTANT: All the needle bearings (18) MUST BE in place inside bearing race while driving the pinion bearing from the gear housing.

IMPORTANT: Do not reuse the bearing (race or rollers) once it has been removed.

1. While holding down on the driver rod, remove and discard the pinion bearing (race and rollers) using tools as shown.



70614

a - Pinion Bearing
b - Bearing Driver (91-36569)
c - Pilot Washer (91-36571)
d - Driver Rod (91-37323)

Gear Housing Reassembly

Gear Housing Inspection

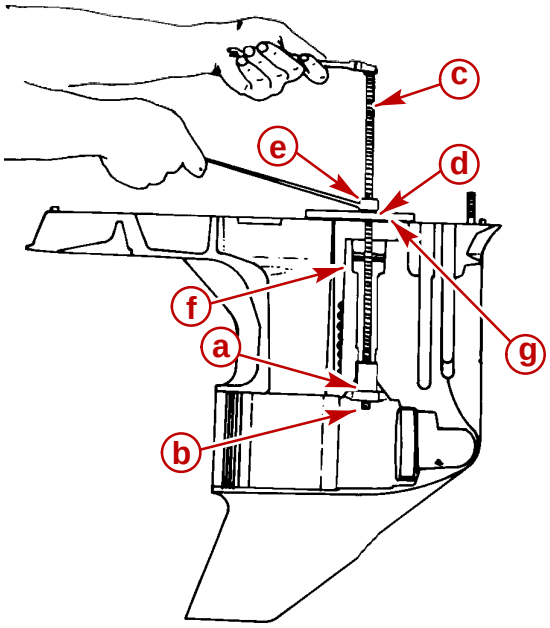
1. Clean the gear housing thoroughly with a suitable solvent and a hard bristle brush. Dry the gear housing thoroughly using compressed air. Ensure that all sealants, locking agents and debris are removed.
2. Inspect the gear housing for excessive corrosion, impact or any other damage. Excessive damage and/or corrosion requires replacement of the gear housing.
3. Inspect the bearing carrier retainer threads in the gear housing for corrosion and/or stripped threads. Excessive damage to the threads requires replacement of the gear housing.
4. Inspect bearing race/cup contact areas for evidence of bearing cup spinning. Check that bearing cups are not loose in bearing bores. Any one bearing bore in which the race/cup is loose may require replacement of the gear housing.
5. Inspect for blockage in water inlet holes and the speedometer hole. Clean as necessary. Be careful not to enlarge the speedometer hole as this could cause erroneous speedometer readings.
6. Make sure that the locating pins are in place in the gear housing and that the corresponding holes in the drive shaft housing are not elongated. The drive shaft may break if the housings are not aligned properly due to missing locating pins or elongated holes.

Pinion Bearing Installation

IMPORTANT: Install only a NEW pinion bearing (race and rollers). Do not reinstall a pinion bearing that has been previously removed from a gear housing.

1. Lubricate the bore into which the pinion bearing is to be installed with Quicksilver High Performance Gear Lube.
2. Position the new pinion bearing onto the driver head, with the lettered and numbered side of the bearing positioned upward.

3. Insert the driver with the bearing assembly into position (by way of the propeller shaft bore) at the drive shaft bore as shown.



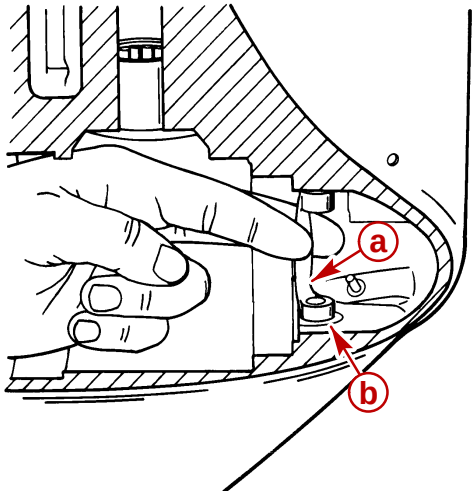
70615

a - Drive Shaft Pinion Bearing
b - Driver Head (91-38628)
c - Puller Shaft (91-31229)
d - Washer (12-34961)
e - Nut (11-24156)
f - Pilot Washer (91-36571)
g - Puller Plate (91-29310)

4. Install the bearing by screwing down the nut until the bearing is fully seated against the bore shoulder.

Shift Shaft Assembly Installation

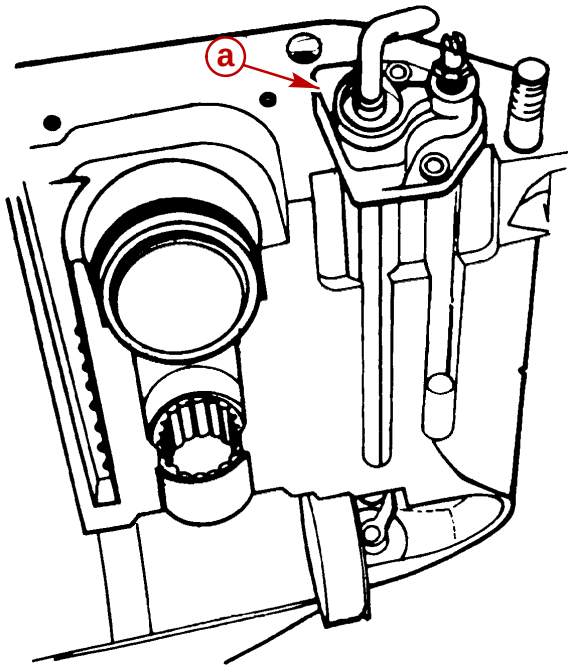
1. Place the shift crank onto the locating pin in the forward section of the gear housing. Ensure that the shift crank faces toward the left (port) side of the gear housing.



50314

a - Shift Crank
b - Locating Pin

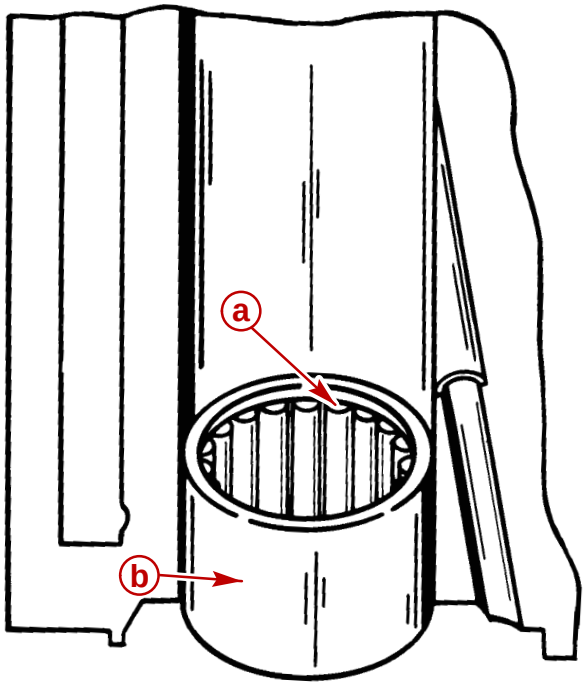
2. Install the shift shaft and bushing assembly into the gear housing as shown. Position the bent end of the shift shaft forward while installing it and ensure that the splined end of the shift shaft is engaged with the shift crank. Make sure that the O-rings are present and positioned properly. Install the screws and tighten to hold the shift shaft into the shift crank.



70620

a - Shift Shaft Assembly

NOTE: *If the pinion bearing needle bearings have fallen out, install 18 needles into needle bearing outer race. Use Quicksilver Needle Bearing Assembly Lubricant to help hold needles in place.*



23142

a - Needles (18)
b - Roller Bearing Outer Race

Reverse Gear Bearing Adaptor Assembly Installation

NOTE: *If the reverse gear, reverse gear adaptor, large thrust bearing or bearing race in the gear housing were not replaced, install the same shim(s) (or the same thickness of shim(s)) that were taken out when adaptor was removed. If the reverse gear, reverse gear adaptor, large thrust bearing, bearing race or gear housing were replaced, install approximately .008 in. (0.51 mm) of shims as a starting point.*

NOTE: *If backlash has already been checked and it has been determined that it needs to be adjusted. Adding .001 in. (0.025 mm) shims will* ***reduce*** *the gear backlash by approximately .001 in. (0.025 mm). Subtracting .001 in. (0.025 mm) shims will* ***increase*** *backlash by approximately the same amount.*

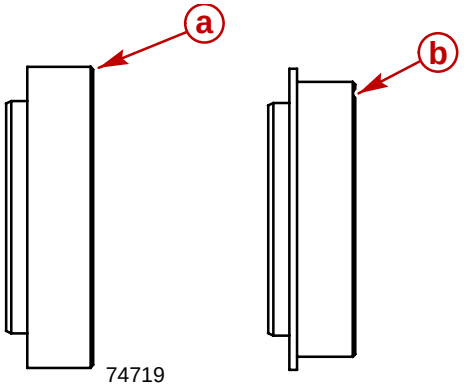
Example 1 (if backlash is too high)

Backlash checks:	.045 in.	(1.14 mm)
(subtract) middle of specification:	.025 in.	(0.64 mm)
You get:	.020 in.	(0.51 mm)
add this quantity of shims:		

Example 2 (if backlash is too low)

middle of specification:	.025 in.	(0.64 mm)
Backlash checks:	.009 in.	(0.23 mm)
(subtract) You get:	.016 in.	(0.41 mm)
subtract this quantity of shims:		

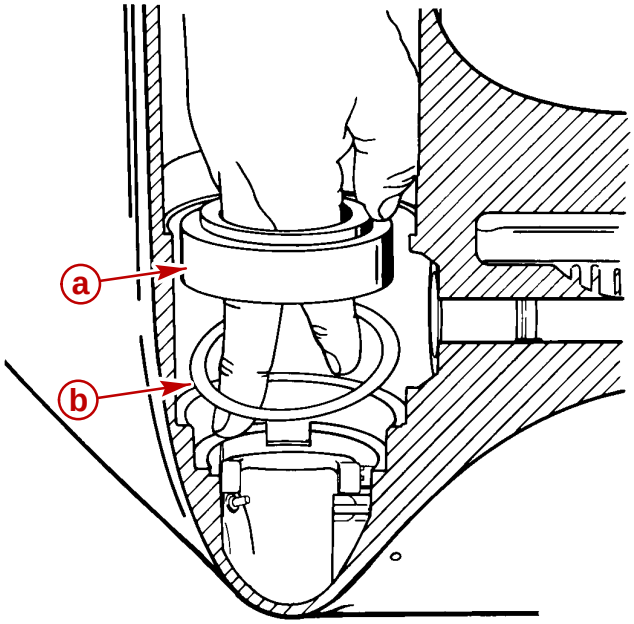
NOTE: *The later style reverse gear bearing adaptor has a smaller diameter than the earlier style adaptor. See “Special Information” on page 3C-8.*



74719 74718

a - Earlier Style Reverse Gear Bearing Adaptor (Prior To S/N OF680000)
b - Later Style Reverse Gear Bearing Adaptor (S/N OF680000 And Above)

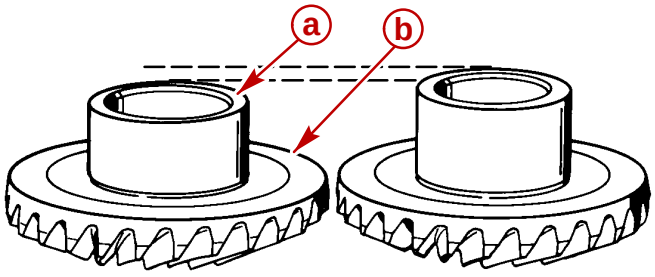
1. Lubricate the bore into which the reverse gear bearing adaptor is to be installed with Quicksilver Special Lubricant 101.
2. Place the shim(s) into reverse bore of gear housing.
3. Position the bearing adaptor in the gear housing.



50781

a - Bearing Adaptor
b - Shims

IMPORTANT: The appearance of the forward and reverse gear is almost identical. There are two ways to distinguish between the reverse gear and forward gears. The reverse gear has a shorter hub and it has a groove cut into the back of the gear just inside the thrust bearing race surface.

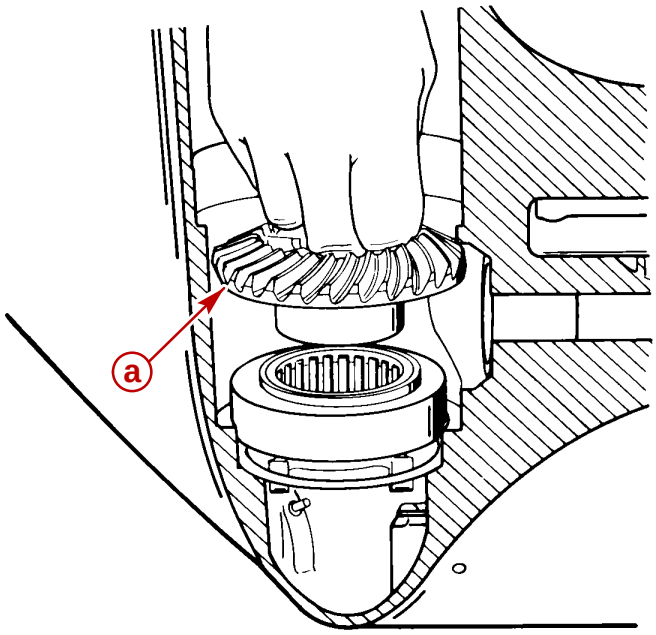


50885

Reverse **Forward**

a - Shorter Hub
b - Groove

4. Position the reverse gear (without the thrust race or thrust bearing) into the gear housing and into the adaptor.



50781

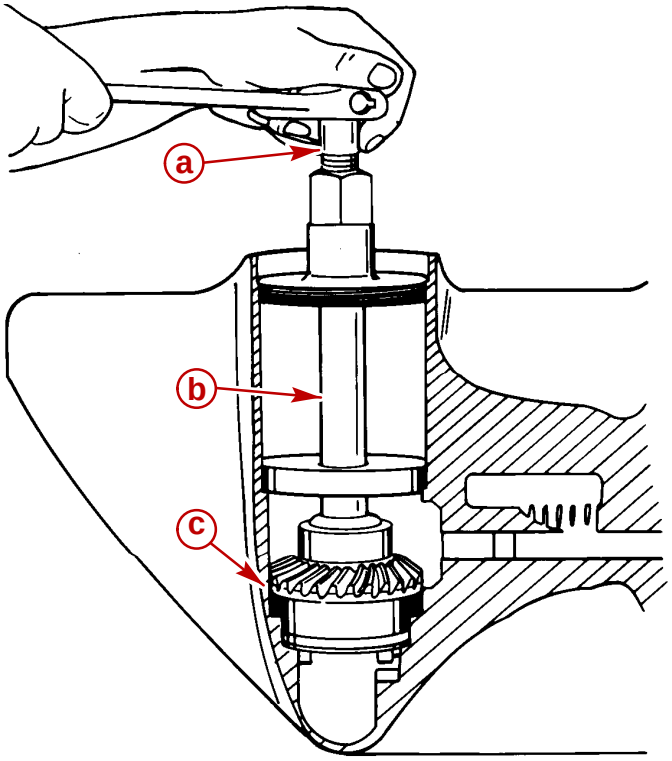
a - Reverse Gear

5. Press the bearing adaptor into the gear housing using the installation tool as follows:

IMPORTANT: Be sure that the bearing adaptor is positioned as straight as possible to avoid cocking it in the bore while pressing it in.

a. Lubricate the threads of the installation tool with Quicksilver Special Lubricant 101.

b. Turn the hex-head screw of the installation tool until the bearing adaptor contacts the gear housing shoulder. DO NOT continue to turn the tool once the screw resistance goes up noticeably.



50791

a - Hex-Head Screw
b - Bearing Adaptor Installation Tool (91-18605 A1)
c - Reverse Gear

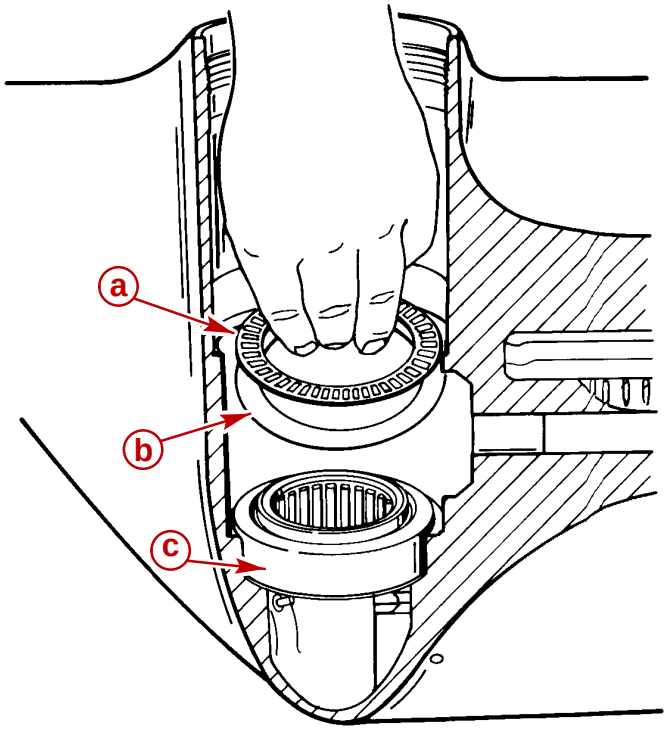
c. Remove the installation tool **and the reverse gear.**

Gear Location/Backlashes Checking and Adjustment

Reverse Gear

INSTALLATION (FOR CHECKING BACKLASH ONLY)

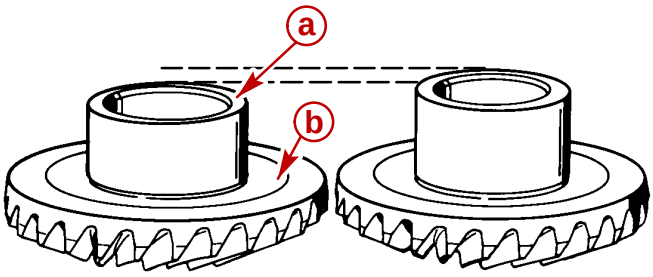
1. Lubricate the large reverse gear thrust bearing with Quicksilver High Performance Gear Lube. First position the thrust race and then the bearing into the gear housing and onto the reverse gear bearing adaptor as shown below.



50882

a - Thrust Bearing
b - Thrust Race
c - Reverse Gear Bearing Adaptor

IMPORTANT: The appearance of the forward and reverse gear is almost identical. There are two ways to distinguish between the reverse and forward gears. The reverse gear has a shorter hub and a groove cut into the back of the gear just inside the thrust bearing race surface.

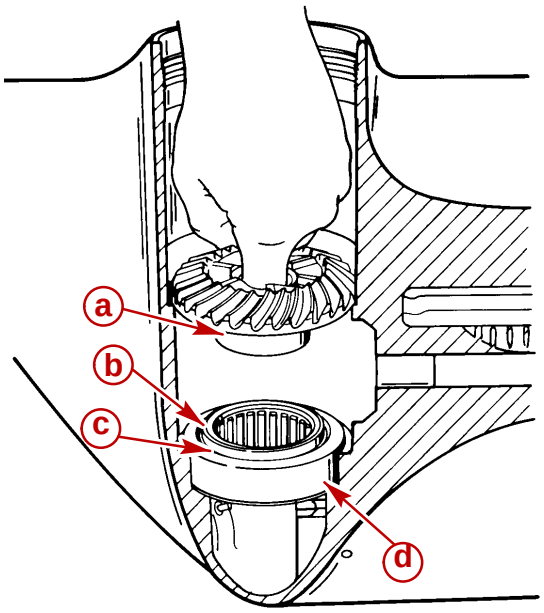


50885

Reverse **Forward**

a - Shorter Hub
b - Groove

2. Assemble the reverse gear into the gear housing and into the reverse gear bearing adaptor.



50884

a - Reverse Gear
b - Thrust Bearing
c - Thrust Race (Under Bearing)
d - Reverse Gear Bearing Adaptor

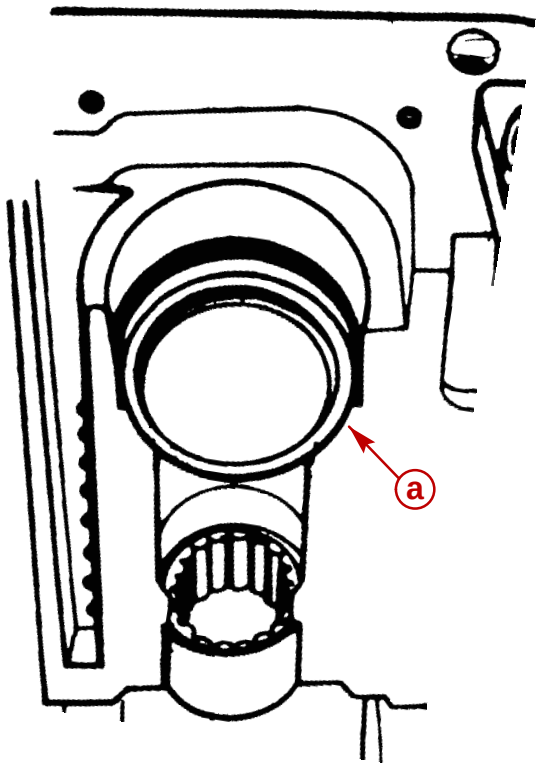
Drive Shaft and Pinion Gear

INSTALLATION (FOR CHECKING GEAR LOCATION AND BACKLASHES ONLY)

NOTE: *If the original shims were not retained or if pinion gear, drive shaft, drive shaft tapered roller bearing and cup or gear housing were replaced start off by installing .038 in. (0.96 mm) shim(s).*

NOTE: *If the original shims were retained (or measurement known) and none of the above listed parts were replaced, reinstall the original shims (or an amount of shims equal to the original shims).*

1. Place the shim(s) into the drive shaft housing bore at the location shown.



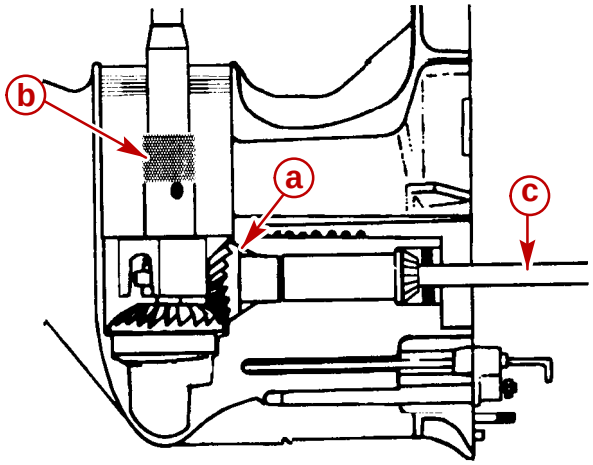
70620

a - Shim(s)

NOTE: *For ease of installation, glue the washer to the tool using 3M Adhesive or equivalent.*

2. Assemble the pinion gear nut into the MR slot of the pinion nut adaptor. A small dab of heavy grease in the slot of the pinion nut adaptor will help hold the nut in the adaptor while installing the drive shaft assembly.
3. Place the pinion gear (with the washer glued to it) into the gear housing.
4. Insert the pinion nut adaptor (with the nut) into the gear housing.
5. Insert the drive shaft into the gear housing drive shaft bore. It may be necessary to rotate the drive shaft to engage the drive shaft splines into the pinion gear splines.

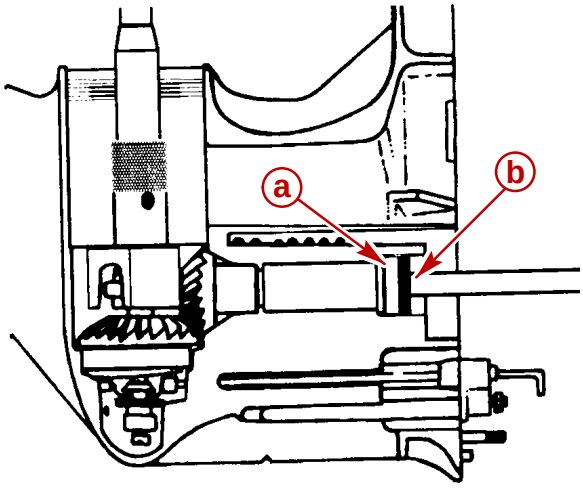
6. Start the pinion nut onto the drive shaft threads by rotating the drive shaft until the nut is snug.



70891

a - Pinion Gear (With The Washer Glued To The Tool)
b - Pinion Nut Adapter (91-61067 A3)
c - Drive Shaft

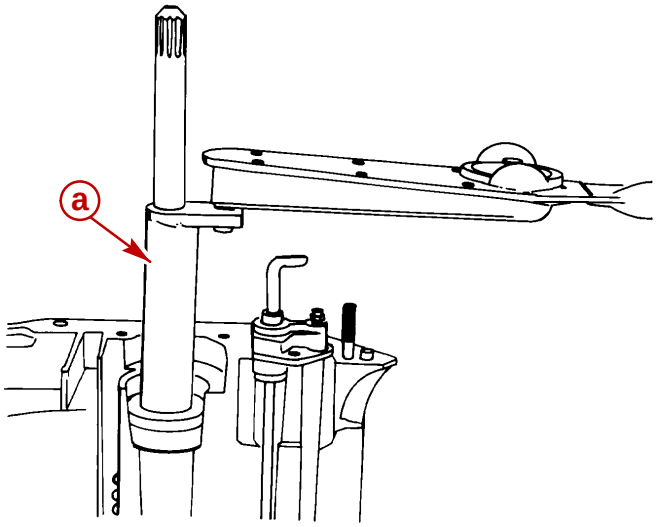
7. Install the drive shaft tapered roller bearing cup then the retainer nut.



70890

a - Tapered Roller Bearing Cup
b - Drive Shaft Retainer

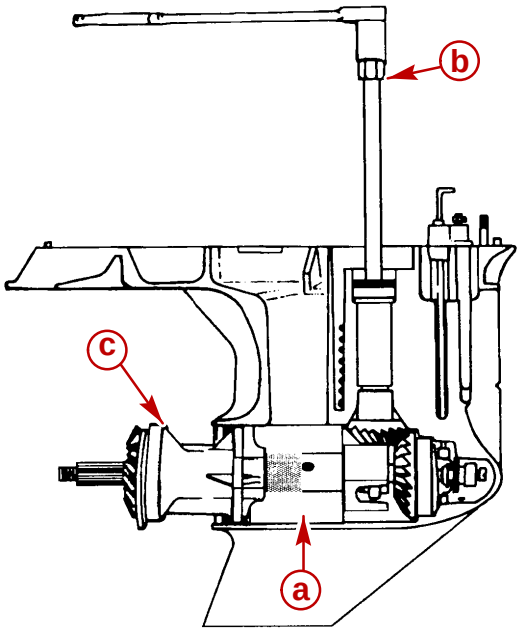
8. Torque the retainer to 100 lb-ft (130 Nm).



70711

a - Drive Shaft Bearing Retainer Wrench (91-43506)

9. Install the bearing carrier into the gear housing backwards to hold the propeller shaft and the pinion nut adapter in position.
10. Torque the pinion nut by turning the drive shaft using the drive shaft nut wrench and torque wrench with the appropriate socket to 70 lb-ft (94 Nm).



70892

a - Pinion Nut Adaptor (91-61067 A3)
b - Drive Shaft Nut Wrench (91-56775)
c - Bearing Carrier (Installed Backwards)

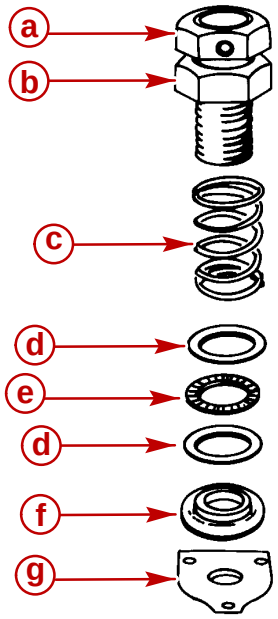
11. Remove the bearing carrier, pinion nut adapter and drive shaft nut wrench.

Drive Shaft - Bearing Preload Tool

INSTALLATION

NOTE: *Ensure that the top nut and the bottom nut of the bearing preload tool are screwed as close together as possible prior to proceeding with the following step.*

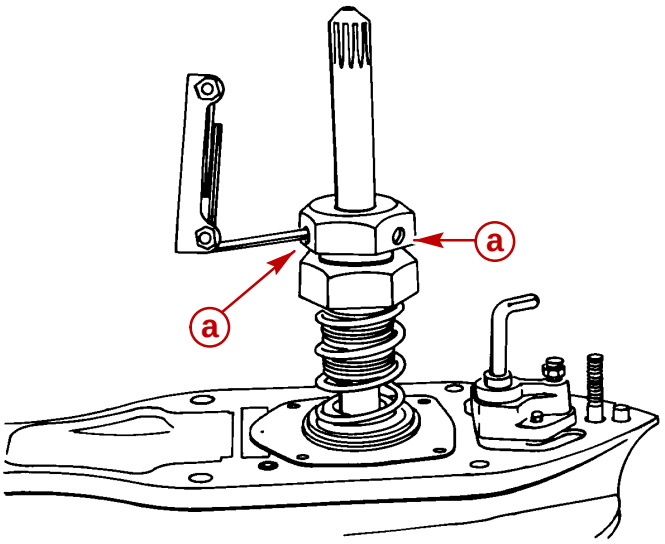
1. Install the components from the Bearing Preload Tool Kit (91-14311A2), over the drive shaft in the order shown.



73885

a - Top Nut With Treaded Pipe
b - Nut
c - Spring
d - Thrust Washer
e - Thrust Bearing
f - Thrust Washer
g - Water Pump Face Plate (From Your Gear Housing)

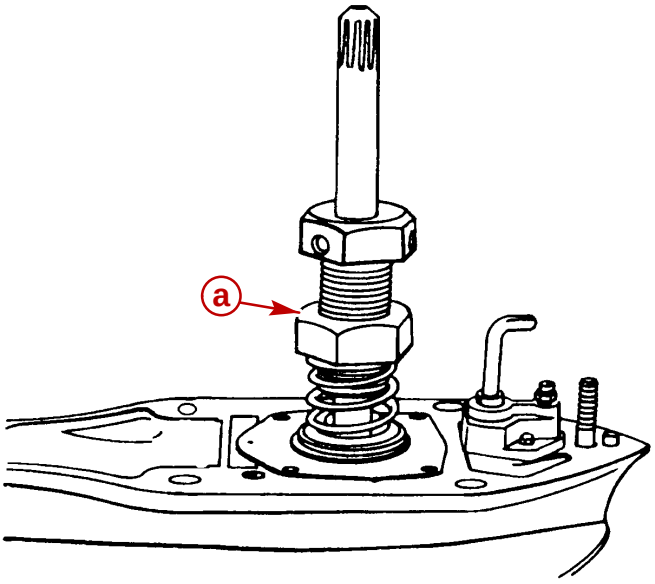
2. Pull up on the drive shaft and tighten the two (2) allen screws in the top nut of the bearing preload tool.



70716

a - Allen Screws

3. Screw the bottom nut of the bearing preload tool down until it is one inch further down the threaded rod than it was previously.



70893

a - Bottom Nut (Screwed Down Approximately 1 in. (25 mm) Further Than It Was Previously)

4. Rotate the drive shaft at least three full turns in a clockwise direction to seat the needle bearing.

Pinion Gear Location

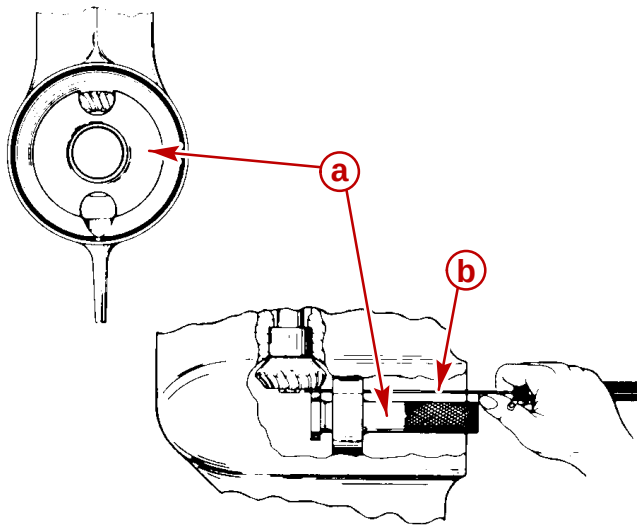
CHECKING

Pinion Gear Location Specification: .025 in. (0.64 mm)

1. Place the pinion gear shimming tool into the gear housing.

NOTE: *Take the following measurements at 3 locations, rotating the drive shaft 120 degrees between each reading (always rotate the drive shaft in a clockwise direction).*

2. Insert the thickest feeler gauge that fits snugly between one tooth of the pinion gear and high point of the shimming tool.



26410

a - Pinion Gear Shimming Tool (91-56048)
b - .025 in. (0.64 mm) Feeler Gauge

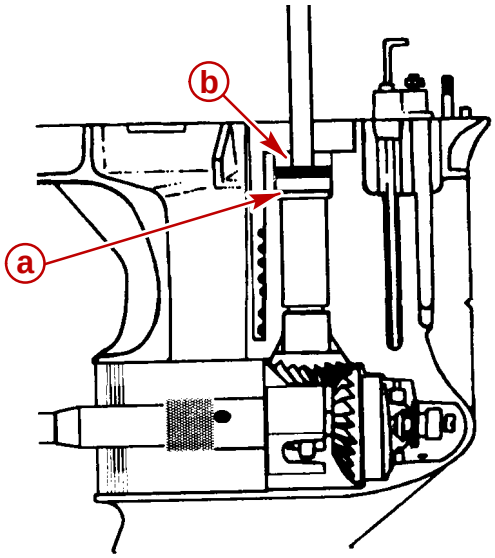
3. Rotate the drive shaft 120 degrees in a clockwise direction and take another reading.
4. Repeat this process until 3 readings have been taken.
5. Add the three readings together and divide the sum by 3 to get the average pinion gear height.
   a. If the (average) pinion gear location does not meet the specification of .025 in. (0.64 mm) proceed with the adjustment instructions .
   b. If the (average) pinion gear location meets specification, proceed to the Reverse Gear Backlash section.

ADJUSTING

NOTE: *Adding .001 in. (.025 mm) shims will increase the gear location by .001 in. (.025 mm). Subtracting .001 in. (.025 mm) will decrease the gear location by .001 in. (.025 mm).*

1. Loosen the preload tool.
2. Remove the drive shaft retainer and the drive shaft tapered roller bearing cup. (The cup can be removed by wiggling the drive shaft back and forth or by turning gear housing over and shaking it.) Add or subtract shims beneath the cup to obtain the proper average pinion gear height.

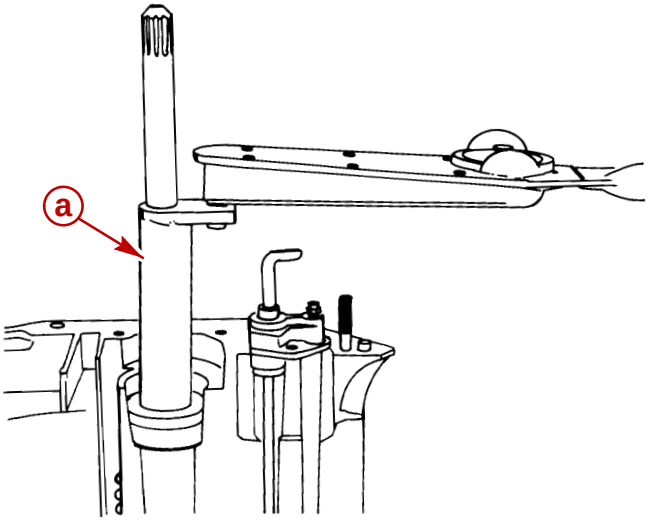
3. Install the drive shaft tapered roller bearing cup then install the retainer.



70890

a - Tapered Roller Bearing Cup
b - Drive Shaft Retainer

4. Torque the retainer to 100 lb-ft (130 Nm).



70711

a - Drive Shaft Bearing Retainer Wrench (91-43506)

5. Reinstall the drive shaft bearing preload tool.
6. Recheck the pinion gear height.

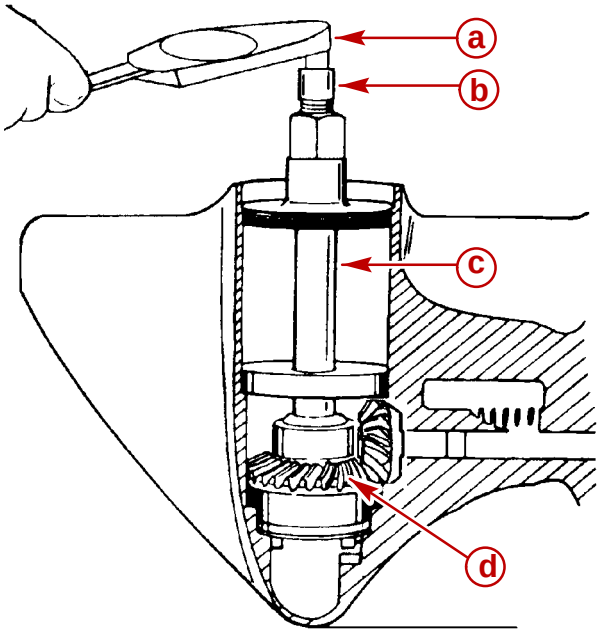
Reverse Gear Backlash

CHECKING

Reverse Gear Backlash Specification: .040-.050 in. (1.02-1.27 mm)

NOTE: *The reverse gear bearing adaptor installation tool is used to apply a light preload to the reverse gear in the following steps.*

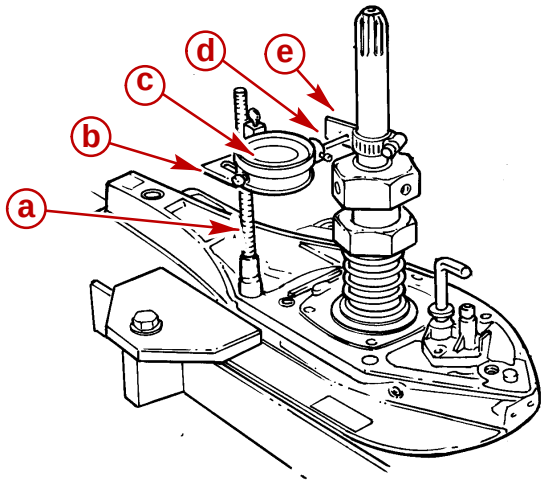
1. Install the reverse gear bearing adaptor installation tool into the gear housing to hold the reverse gear against the thrust bearing as follows:
   a. Assemble the reverse gear bearing adaptor installation tool into the gear housing and tighten it by hand until a slight resistance is felt.
   b. Torque the adaptor's driver bolt to 45 lb-in. (5 Nm).



70973

b - Torque Wrench (91-66274)
c - Driver Bolt
d - Bearing Adaptor Installation Tool (91-18605A1)
e - Reverse Gear

2. Install a dial indicator as shown in the following figure.



77706

a - Threaded Rod [3/8 in. (9.5 mm) Obtain Locally]
b - Dial Indicator Holding Tool
c - Backlash Indicator
d - Indicator Pointer
e - Backlash Indicator Rod

IMPORTANT: Throughout this process, ensure the dial indicator stay perpendicular with the flag.

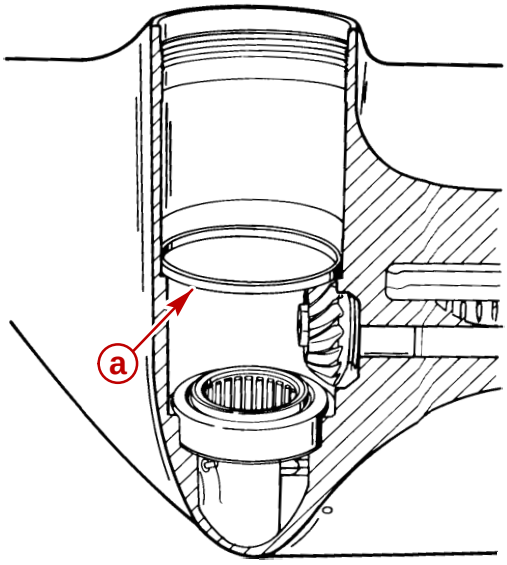
3. **For All Gears Except 14:28:** Install backlash indicator (P/N 91-58222 A1) and align the indicator pointer so that it is perpendicular to and touching the “I” mark on the dial indicator rod.
4. **For 14:28 Gears:** Install backlash indicator (91-78473) and align the indicator pointer so that it is perpendicular to and touching the “2” mark on the dial indicator rod.
5. Align the indicator pointer so that it is perpendicular to and touching the “I” mark on the dial indicator rod. Tighten the indicator rod onto the drive shaft and rotate the drive shaft so that the needle in the dial makes at least one full revolution and comes to the “0” mark on the dial indicator scale.
6. Take the backlash readings by lightly turning the drive shaft back and forth, so you can feel the backlash between the gears.
   a. Observe the backlash indicator and record the reading.
   b. Loosen the indicator rod and rotate the drive shaft 90 degrees in a clockwise direction.
   c. Repeat Step 3 and 4 above until a total of 4 backlash readings have been taken.
7. Loosen the backlash indicator rod and remove the Reverse Gear Bearing Installation Tool.
8. Add the four readings together and divide the sum by four. This is your average backlash. Make note of this figure. If it does not meet the specification of .040-.050 in. (1.02 -1.27 mm), complete the following:
   a. **If The (Average) Backlash Is To Specification,** proceed to the Forward Gear Backlash section.

NOTE: *Adding .001 in. (0.025 mm) shims will increase the gear location by .001 in. (0.025 mm). Subtracting .001 in. (0.025 mm) will decrease the gear location by .001 in. (0.025 mm).*

   b. **If The (Average) Backlash Is Not To Specification,** change the amount of shims beneath the reverse gear bearing adaptor. Refer to page 3C-37.

Forward Gear Backlash

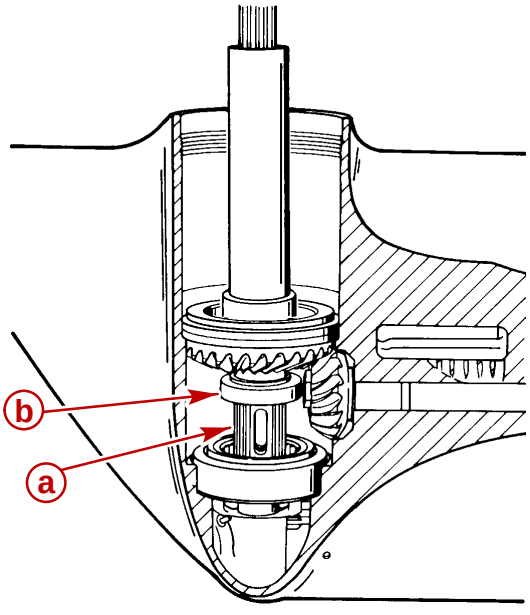
1. Install the appropriate spacer shim into the gear housing.



50882

a - Shim

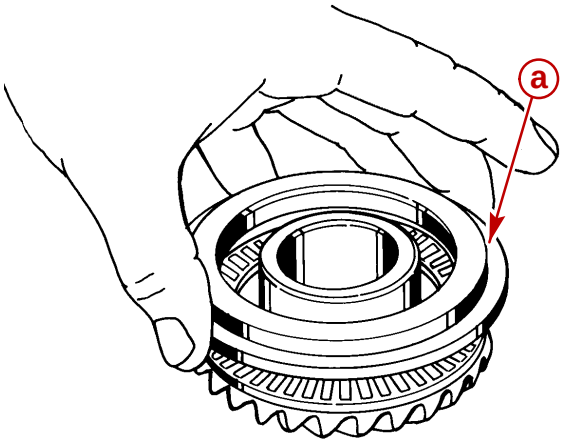
2. Insert propshaft into housing with one thrust collar on shaft and resting on splined area.



50889

a - Splined Area
b - Thrust Collar

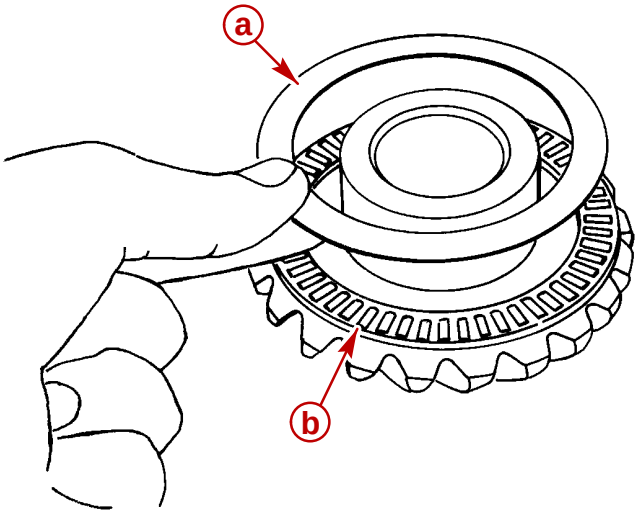
3. If equipped, place the thrust race or washer on top of the thrust bearing with the **stepped side up** as shown in the following figure.



50785

a - Thrust Race

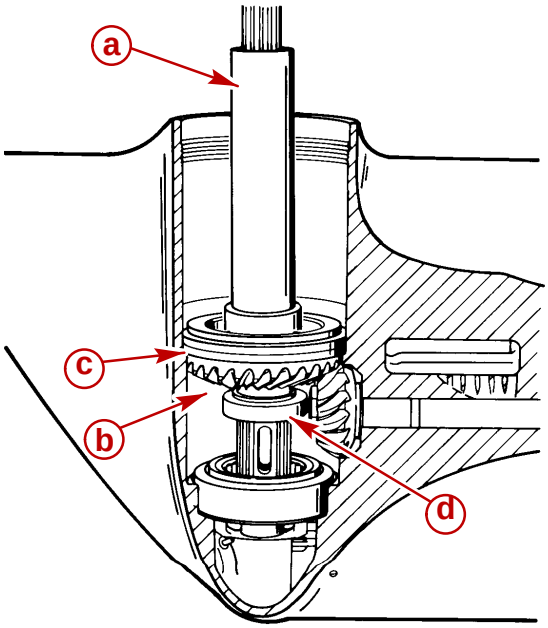
NOTE: *The thrust race has been replaced with a thrust washer on S/N OF680000 and above models.*



74886

a - Thrust Washer
b - Thrust Bearing

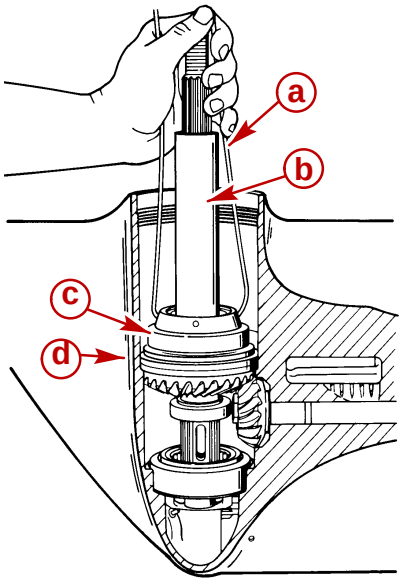
4. Assemble the forward gear installation tool to the forward gear. Then place it (with the forward gear, thrust bearing and thrust race, if applicable) down over the propeller shaft. Ensure that the thrust race seats evenly onto the shim. Tap the thrust race down lightly with a soft tool; do not damage the thrust race surface.



50889

a - Forward Gear Installation Tool (91-815850)
b - Forward Gear
c - Spacer Shim
d - Thrust Race

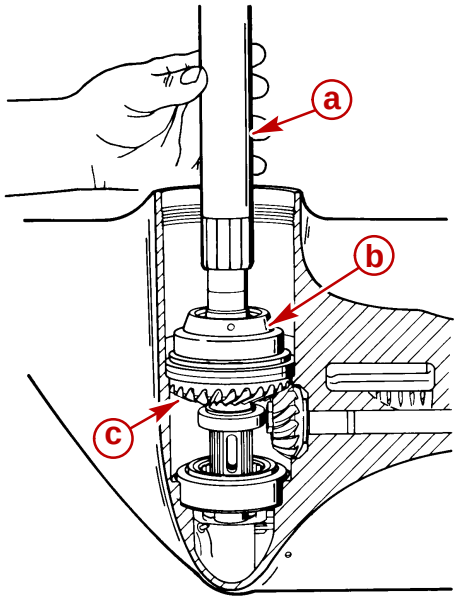
5. Install the forward gear bearing adaptor using a hook tool (which was fashioned when the adaptor was removed) as shown. Ensure that the adaptor seats evenly against the thrust race.



50889

a - Hook Tool
b - Forward Gear Installation Tool (91-815850)
c - Forward Gear Bearing Adaptor
d - Thrust Race

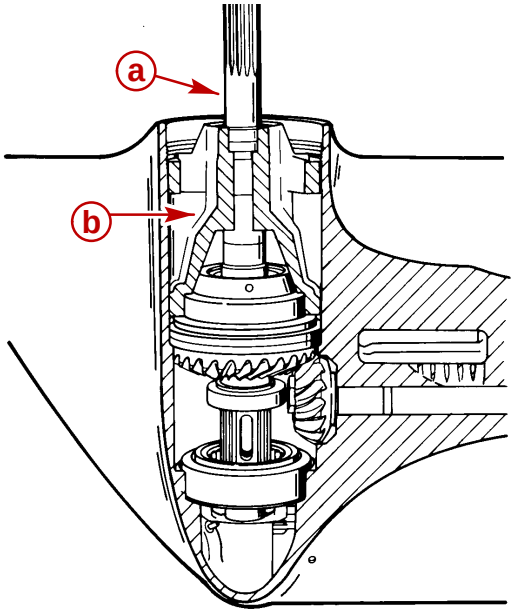
6. Remove the hook tool and, while holding down on the forward gear, remove the forward gear installation tool.



50889

a - Forward Gear Installation Tool (91-815850)
b - Forward Gear Bearing Adaptor
c - Forward Gear

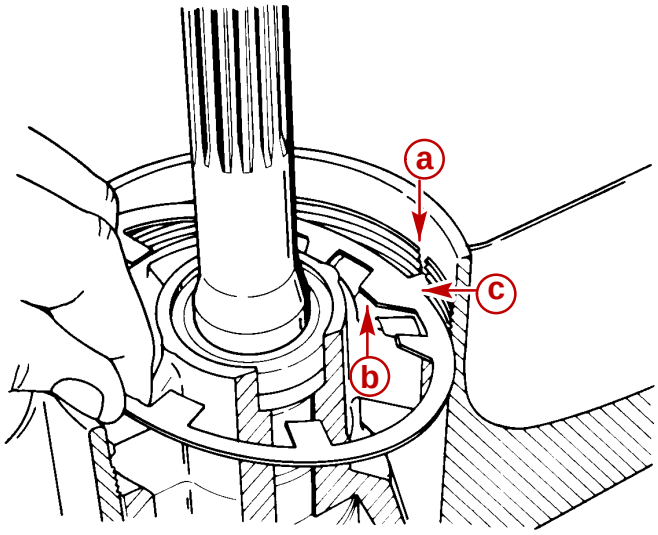
7. Lower the bearing carrier down over the propeller shaft until it is fully seated.



50888

a - Propeller Shaft
b - Bearing Carrier

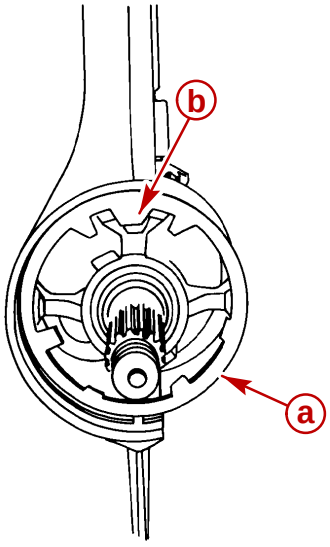
8. Align the bearing carrier “V” shaped notch with the alignment hole in the gear housing and then install the tab washer with the external tab inserted into the hole in the gear housing.



50779

a - Gear Housing Tab Washer Alignment Hole
b - “v” Shaped Notch In Bearing Carrier
c - Alignment Tab Of Tab Washer

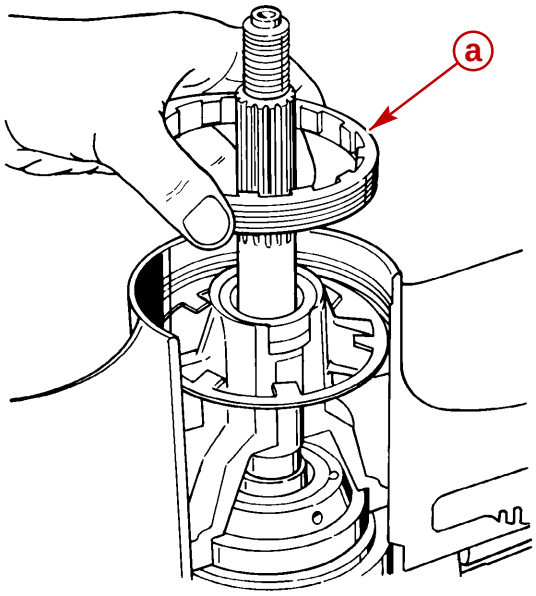
9. Ensure that the “V” shaped tab aligns with the “V” notch in bearing carrier.



70714

a - Tab Washer
b - “V”-Tab

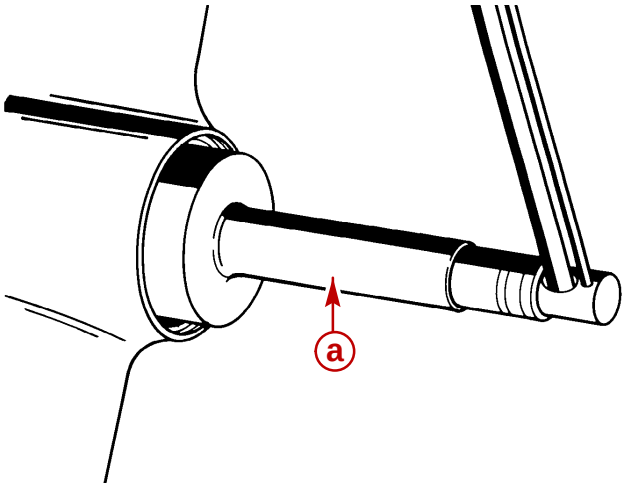
10. Generously lubricate the bearing carrier retainer threads with Quicksilver Special Lubricant 101. Start the retainer into the gear housing threads and screw it down fully by hand.



50881

a - Bearing Carrier Retainer

11. Torque the bearing carrier retainer to 210 lb-ft (285 Nm).

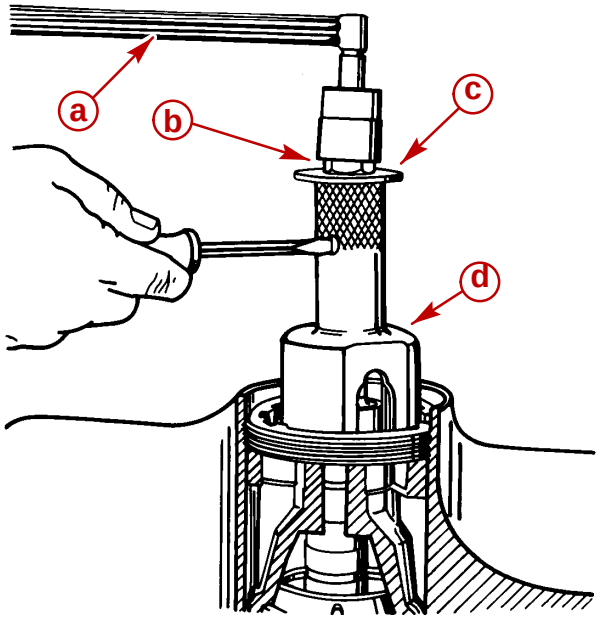


23355

a - Bearing Carrier Retainer Wrench (91-61069)

12. Apply backward pressure to propeller shaft as follows:
    a. Install the pinion nut adaptor, washer and propeller nut as shown in the figure below.

b. Using a flat tip screwdriver placed through the access hole of the pinion nut adaptor to prevent the propeller shaft from rotating, torque the propeller nut to 45 lb-in. (5 Nm). Rotate drive shaft three full turns clockwise and retorque the nut to 45 lb-in. (5 Nm).

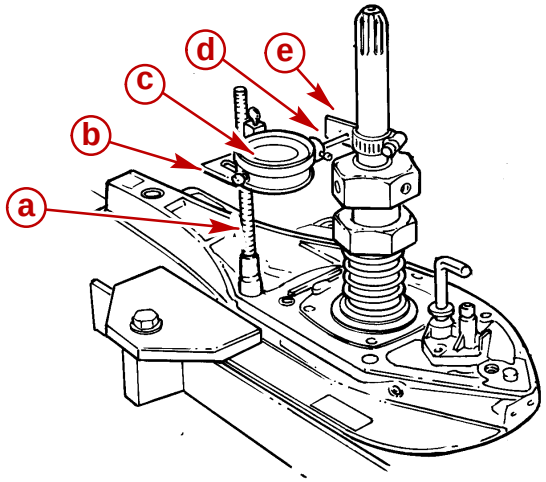


50880

a - Torque Wrench (91-66274)
b - Propeller Nut
c - Washer (91-54048)
d - Pinion Nut Adaptor (91-61067A3)

NOTE: *If the bearing preload tool has not already been set up, install it at this time.*

13. Install a dial indicator as shown in the following figure.



77706

a - Threaded Rod [3/8 in. (9.5 mm) Obtain Locally]
b - Dial Indicator Holding Tool
c - Backlash Indicator
d - Indicator Pointer
e - Backlash Indicator Rod

14. Align the backlash indicator pointer so that it is perpendicular to and touching the “I” mark on the dial indicator rod. Tighten the indicator rod onto the drive shaft and rotate the drive shaft so that the needle in the dial makes at least one full revolution and comes to “0” on the dial indicator scale.
15. Take the backlash readings by lightly turning the drive shaft back and forth, so you can feel the backlash between the gears.
    a. Observe the backlash indicator and record the reading.
    b. Loosen the indicator rod and rotate the drive shaft 90 degrees in a clockwise direction.
    c. Repeat step “a” and “b” above until a total of 4 backlash readings have been taken.
    d. Add the four readings together and divide the sum by four. This is your average backlash. Make note of this figure. If it does not meet specifications of .017-.028 in. (0.43-0.71 mm), it will be adjusted at a later step.
16. Loosen the backlash indicator rod and remove the dial indicator and its supporting tooling.
17. Remove the propeller nut, washer and the pinion nut adaptor.
    a. **If The Backlash Is To Specification,** skip the next step (17b) and go on to step 18 following.

NOTE: *Installing a .002 in. (.051 mm) thinner spacer shim will decrease the gear backlash by .002 in. (.051 mm). Installing a .002 in. (.051 mm) thicker shim will increase the gear backlash by .002 in. (.051 mm).*

    b. **If The Backlash Is Not To Specification,** complete the following instructions to install a different size spacer shim under the forward gear thrust race.
        (1.) Remove the bearing carrier retainer, tab washer and the bearing carrier.
        (2.) Using the hook tool, remove the forward gear bearing adaptor.
        (3.) Insert the forward gear installation tool into the forward gear and remove the forward gear, thrust bearing and thrust race.
        (4.) Remove the spacer shim.
18. Remove the items as outlined following:
    a. Remove the bearing carrier retainer, tab washer and the bearing carrier.
    b. Using the hook tool remove the forward gear bearing adaptor.
    c. Insert the forward gear installation tool into the forward gear and remove the forward gear, thrust bearing and thrust race.
    d. Remove the spacer shim.
    e. Remove drive shaft preload tool.
    f. Remove drive shaft assembly.
    g. Remove the reverse gear.

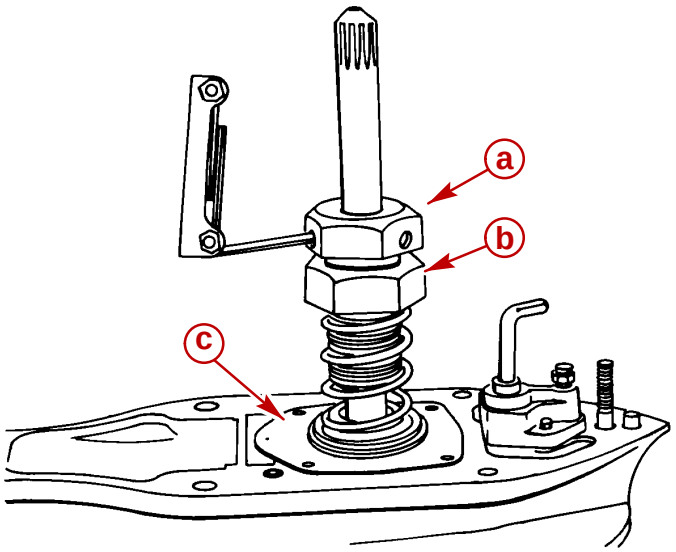
Drive Shaft - Bearing Preload Tool

REMOVAL

⚠ CAUTION

Before loosening the top nut allen screws of the bearing preload tool, screw the bottom nut up as close as possible to the top nut.

1. Screw the bottom nut of the bearing preload tool until it is as close as possible to top nut.
2. Loosen the allen screws in the top nut.
3. Remove all components including the water pump face plate.



70716

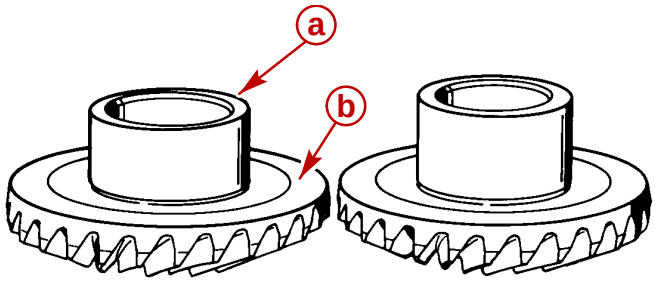
a - Top Nut (With Allen Screws)
b - Bottom Nut
c - Water Pump Face Plate

Propeller Shaft Assembly

Component Reassembly

IMPORTANT: The appearance of the forward and reverse gear is almost identical. There are two ways to distinguish between the reverse gear and forward gears. The

reverse gear has a shorter hub and it has a groove cut into the back of the gear just inside the thrust bearing race surface.

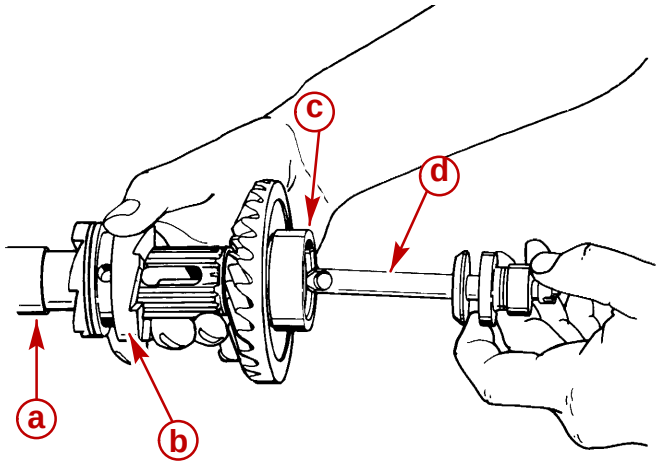


50885

Reverse **Forward**

a - Shorter Hub
b - Groove

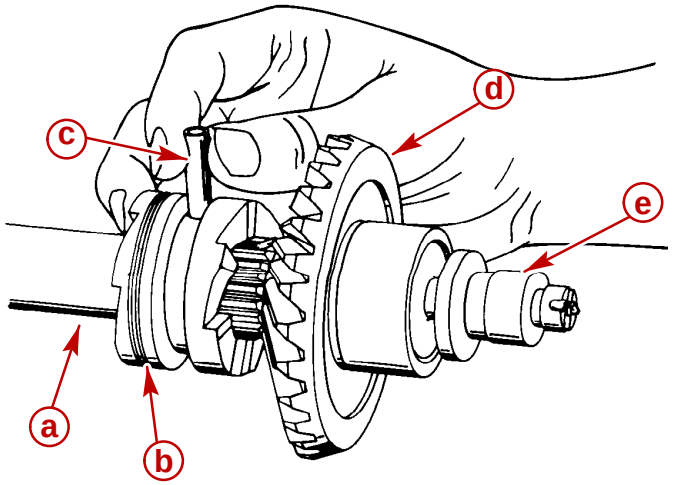
1. Assemble the sliding clutch on the propeller shaft, being sure to align cross pin holes in the clutch with the slot in the propeller shaft. Make sure that the sliding clutch is placed on the propeller shaft with the grooved end of the clutch facing the propeller end of the shaft.
2. Assemble the reverse gear onto the propeller shaft.
3. Assemble the shift spool assembly to the propeller shaft being sure to align the cross pin hole of the shift spool shaft with the clutch slot.



50881

a - Propeller Shaft
b - Sliding Clutch
c - Reverse Gear
d - Shift Spool Assembly

4. Assemble the cross pin through the sliding clutch, propeller shaft and shift spool shaft hole.

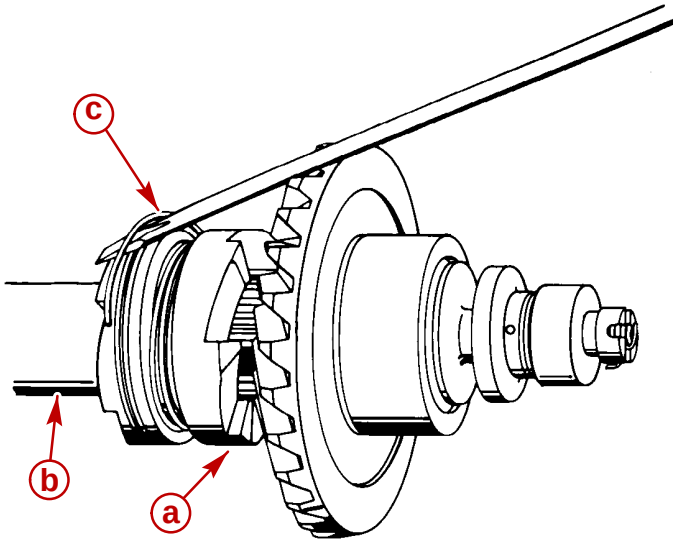


50885

a - Propeller Shaft
b - Sliding Clutch
c - Cross Pin
d - Reverse Gear
e - Shift Spool Assembly

5. Assemble the cross pin retaining spring over the propeller shaft and wind it around the clutch over the cross pin hole. Be careful not to distort the spring while assembling it.

IMPORTANT: Make sure that the spring is wound on so that it does not cross over on itself and that it lies flat against the clutch once it is assembled. If it does not lie flat against the clutch a new spring must be installed.

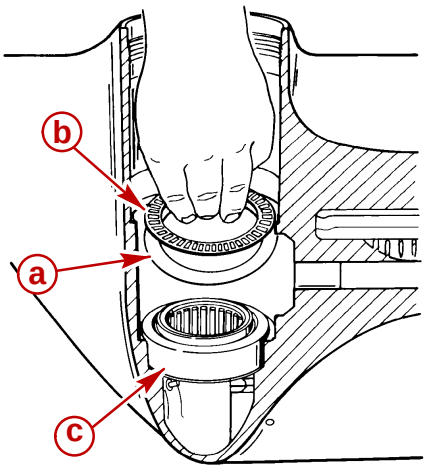


50885

a - Sliding Clutch
b - Propeller Shaft
c - Cross Pin Retaining Spring

Installation

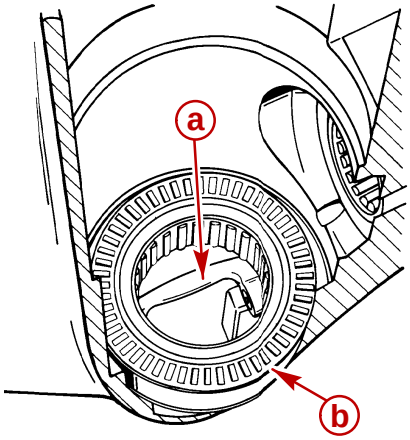
1. Lubricate the large thrust bearing with Quicksilver High Performance Gear Lube. Position the thrust race and then the bearing into the gear housing onto the reverse gear bearing adaptor as shown following.



50882

a - Thrust Race
b - Thrust Bearing
c - Reverse Gear Bearing Adaptor

2. Rotate the shift crank toward the aft end of the gear housing until it touches against the bearing adaptor. Hold it in this position.

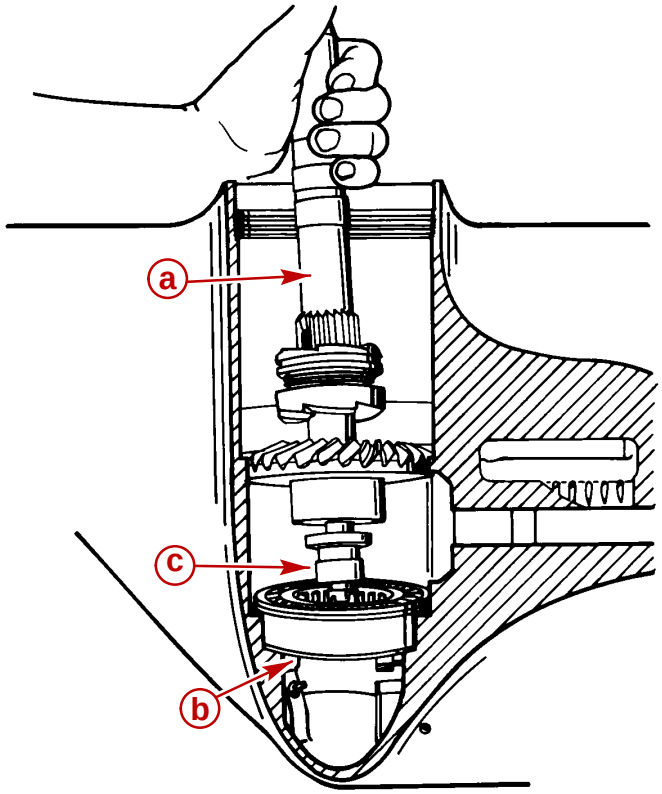


50885

a - Shift Crank
b - Bearing Adaptor

IMPORTANT: Be careful when inserting the propeller shaft assembly into the gear housing as the needle bearings in the reverse gear bearing adaptor can become dislodged when installing it. If it is suspected that a needle has become dislodged, remove the propeller shaft assembly. Inspect the needle bearing cages for damage. If the cages have not been damaged and a needle bearing is positioned wrong, it can be snapped back into place.

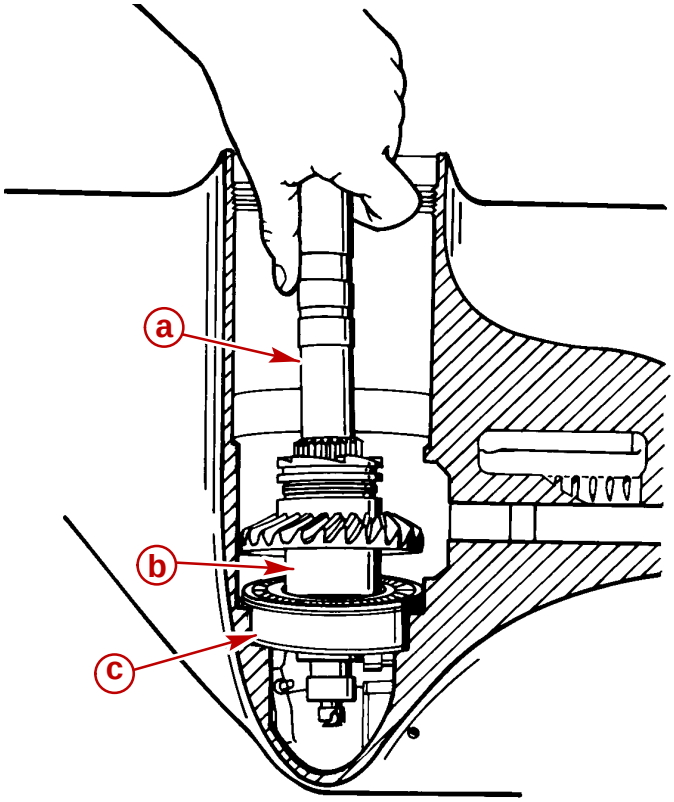
3. To allow for the engagement of the shift spool with the shift crank, tilt the propeller end of the propeller shaft assembly to the left (port) side of gear housing and begin to lower it into the gear housing.



50888

a - Shift Actuating Spool
b - Shift Crank
c - Propeller Shaft Assembly

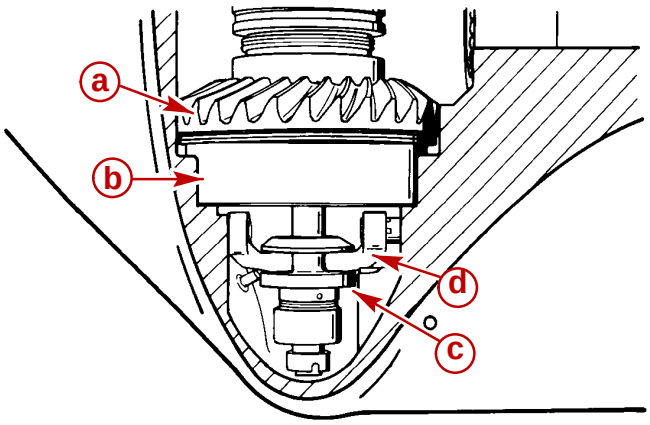
4. With the propeller shaft assembly tilted to the port side of the gear housing, continue to lower the assembly until the reverse gear hub comes into contact with the reverse gear bearing adaptor and the propeller shaft is fully inserted into the reverse gear.



50888

a - Propeller Shaft
b - Reverse Gear Hub
c - Bearing Adaptor

5. Slowly move the propeller shaft to the center of the housing and lower the reverse gear into the bearing adaptor. The shift spool should engage with the shift crank as the propeller shaft centers.



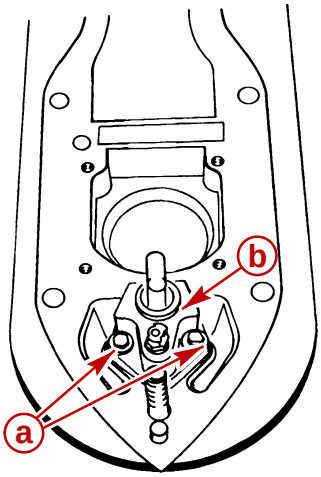
50885

a - Reverse Gear
b - Bearing Adaptor
c - Shift Spool
d - Shift Crank

IMPORTANT: The shift shaft must point forward when the shaft is rotated clockwise. If it does not lift it up slightly and realign the lower shift shaft splines into the shift crank. Recheck to make sure that it is now aligned correctly.

6. Operate the shift shaft to ensure that it has been properly installed. The sliding clutch should move forward when the shift shaft is turned clockwise and should move aft when the shift shaft is turned counterclockwise.

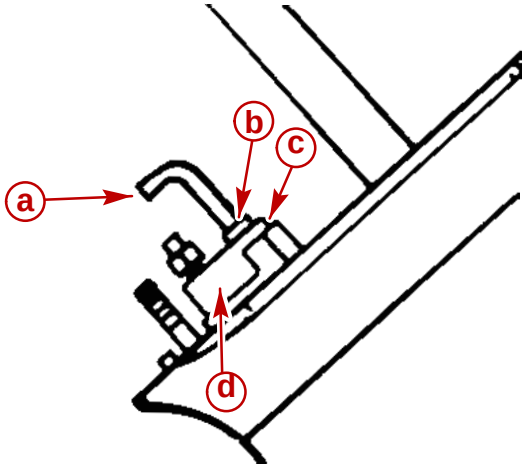
7. Torque the screws that secure the shift shaft bushing to 60 lb-in. (6.8 Nm). **Recheck the shift shaft alignment as noted in the preceding IMPORTANT statement.**



70888

a - Screws (2)
b - Shift Shaft Bushing

8. Slide the rubber sleeve at top end of shift shaft down so that it just touches the oil seal in the bushing.



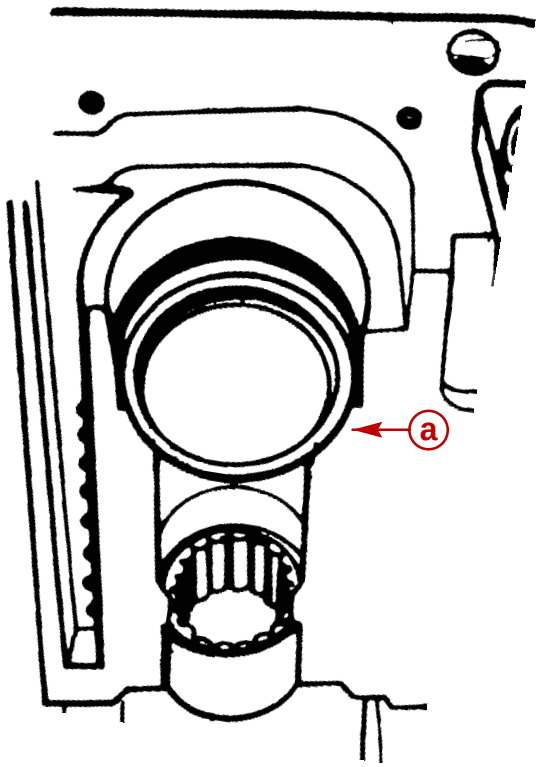
70492

a - Shift Shaft
b - Rubber Sleeve
c - Oil Seal
d - Shift Shaft Bushing

Drive Shaft and Pinion Gear

Final Installation

1. Place the shim(s) into the drive shaft housing bore at the location shown.



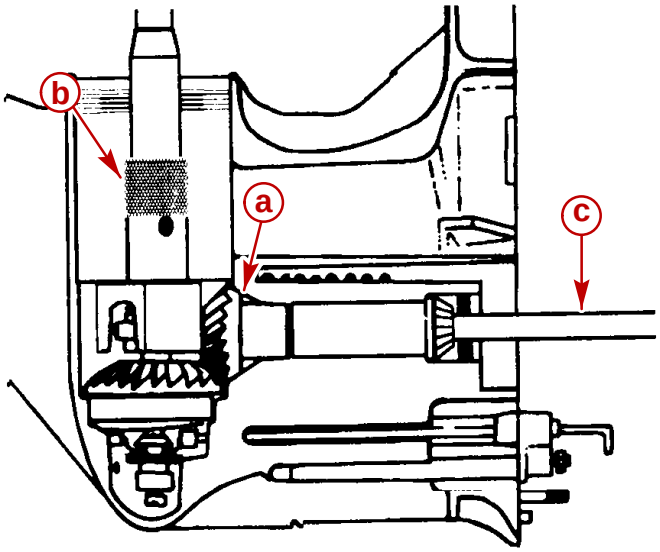
70620

a - Shim(s)

NOTE: *For ease of installation, glue the washer to the pinion gear using 3M Adhesive or equivalent.*

2. Apply Loctite 271 to the threads of the pinion gear nut and place the pinion gear nut (chamfer side toward the pinion gear) into the MR slot of the pinion nut adapter. A small amount of heavy grease in the slot of the pinion nut adapter will help hold the nut in the adaptor while installing the drive shaft assembly.
3. Place the pinion gear (with the washer glued to it) into the gear housing.
4. Insert the pinion nut adapter (with the nut assembled to it) into the gear housing.
5. Insert the drive shaft into the gear housing drive shaft bore. It may be necessary to rotate the drive shaft to engage the drive shaft splines into the pinion gear splines.

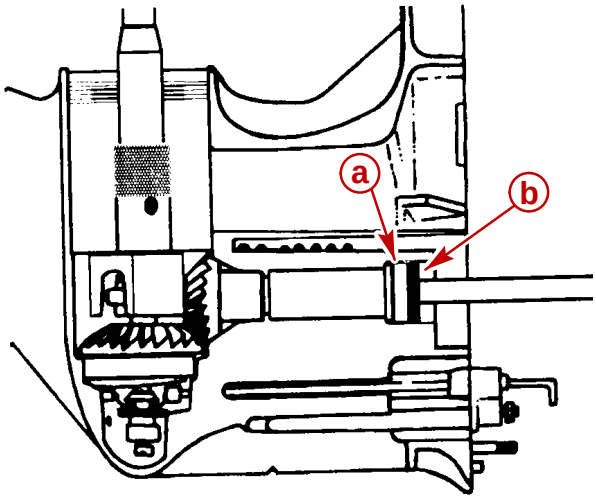
6. Start the pinion nut onto the drive shaft threads by rotating the drive shaft until the nut is snug.



70891

a - Pinion Gear (With The Washer Glued To It)
b - Pinion Nut Adaptor (91-61067A3)
c - Drive Shaft

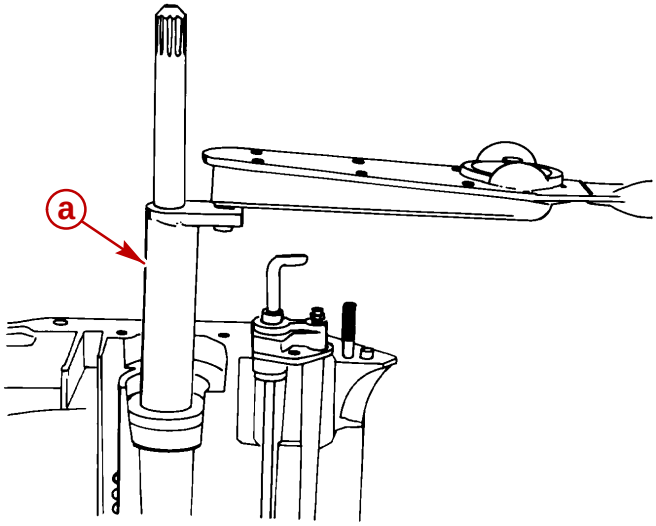
7. Install the drive shaft tapered roller bearing cup then the retainer.



70890

a - Tapered Roller Bearing Cup
b - Drive Shaft Retainer

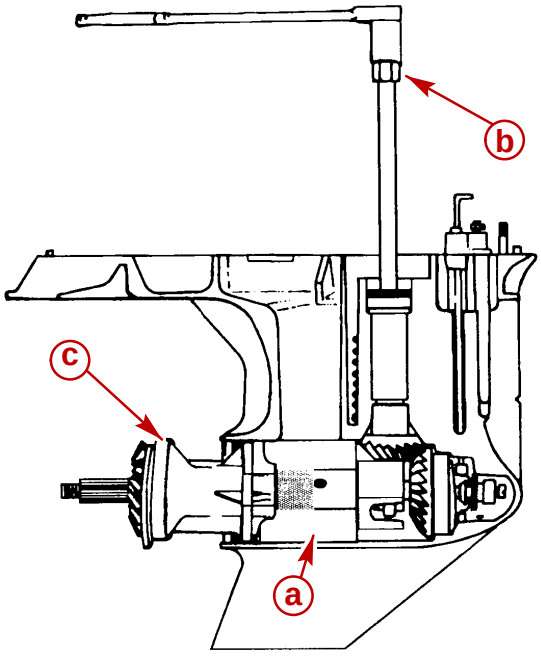
8. Torque the retainer to 100 lb-ft (130 Nm).



70711

a - Drive Shaft Bearing Retainer Wrench (91-43506)

9. Install the bearing carrier into the gear housing backwards to hold the propeller shaft and the pinion nut adapter in position.
10. Torque the pinion nut by turning the drive shaft using the drive shaft nut wrench and torque wrench with the appropriate socket, to 70 lb-ft (96 Nm).



70892

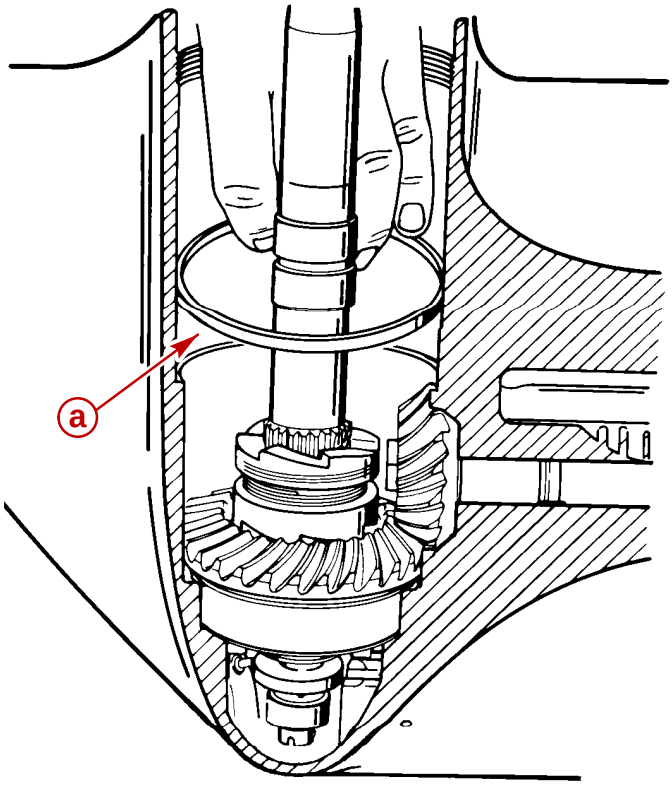
a - Pinion Nut Adapter (91-61067A3)
b - Drive Shaft Nut Wrench (91-56775)
c - Bearing Carrier (installed backwards)

11. Remove the bearing carrier, pinion nut adapter and drive shaft nut wrench.

Bearing Carrier Assembly

Final Installation

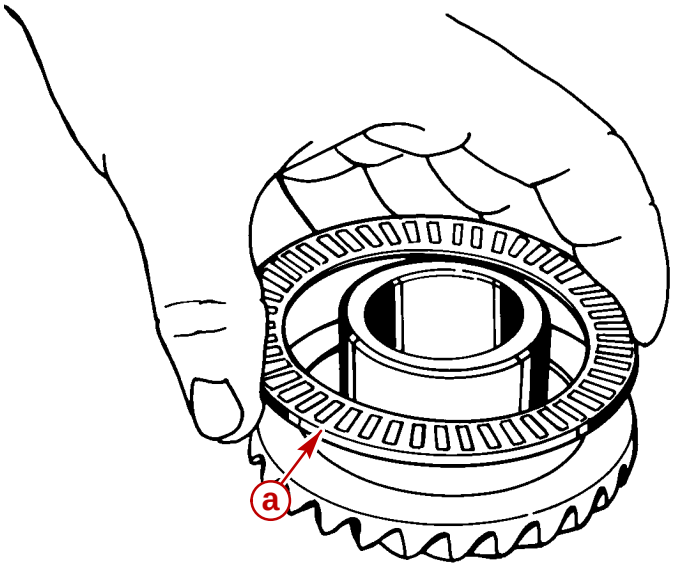
1. Install the appropriate spacer shim into the gear housing.



50782

a - Shim

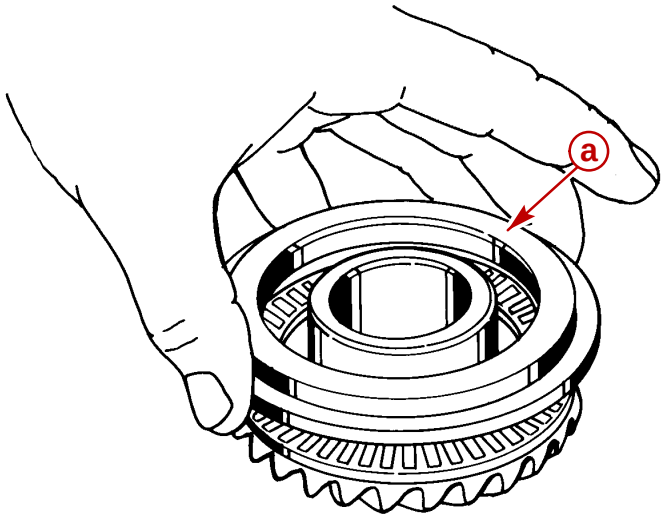
2. Lubricate the thrust bearing with Quicksilver High Performance Gear Lube and place it onto the forward gear.



50785

a - Thrust Bearing
b - Forward Gear

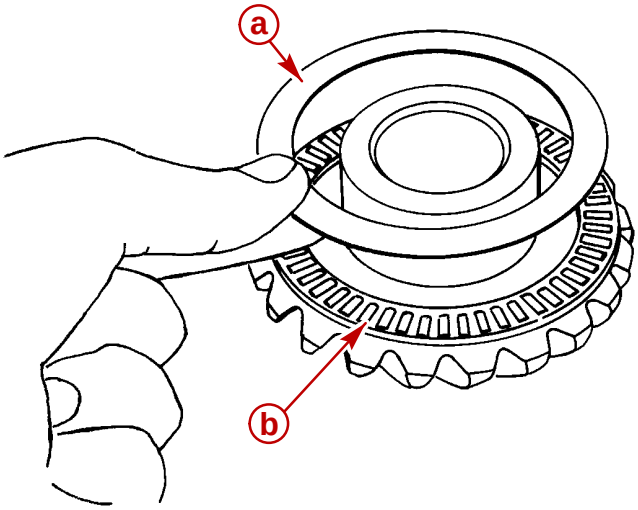
3. Place the thrust race on top of the thrust bearing with the **stepped side up** as shown in the following figure.



50785

a - Thrust Race

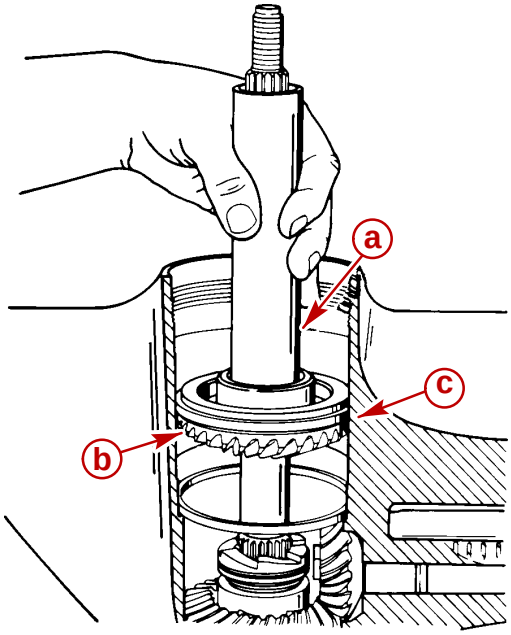
NOTE: *The latest style adapter will use a thrust washer to ride against the adapter face.*



74886

a - Thrust Washer
b - Thrust Bearing

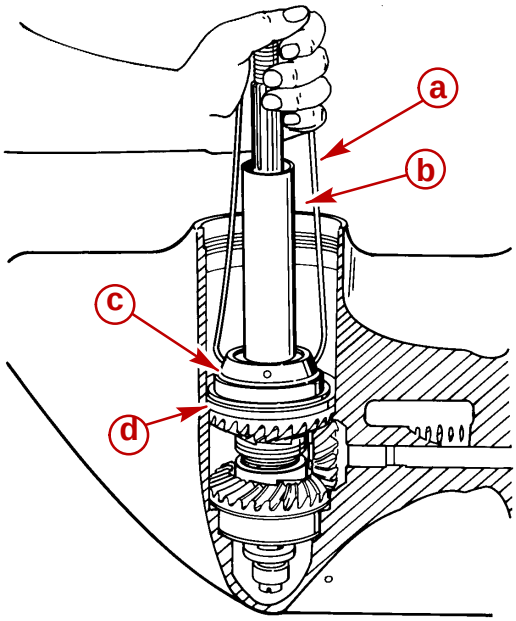
4. Use the Forward Gear Installation Tool (91-815850) to install the forward gear down over the propeller shaft. Ensure that the thrust race seats evenly onto the shim. Tap the race down lightly using a soft punch; do not damage the thrust race surface.



50783

a - Forward Gear Installation Tool (91-815850)
b - Forward Gear
c - Thrust Race

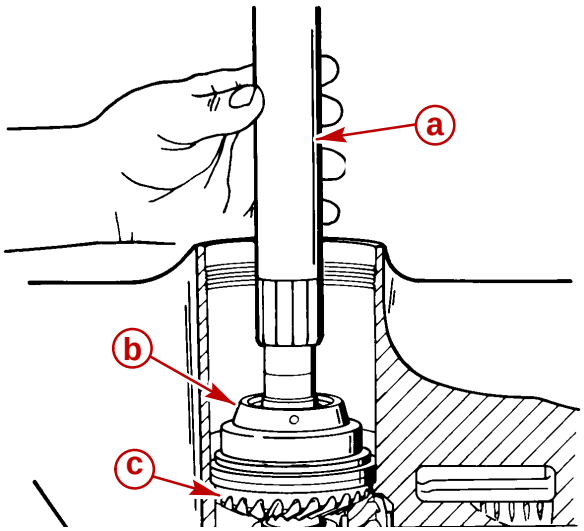
5. Install the forward gear bearing adaptor using a hook tool (which was fashioned when the adaptor was removed) as shown. Ensure that the adaptor seats evenly against the thrust race.



50881

a - Hook Tool
b - Forward Gear Installation Tool (91-815850)
c - Forward Gear Bearing Adaptor
d - Thrust Race

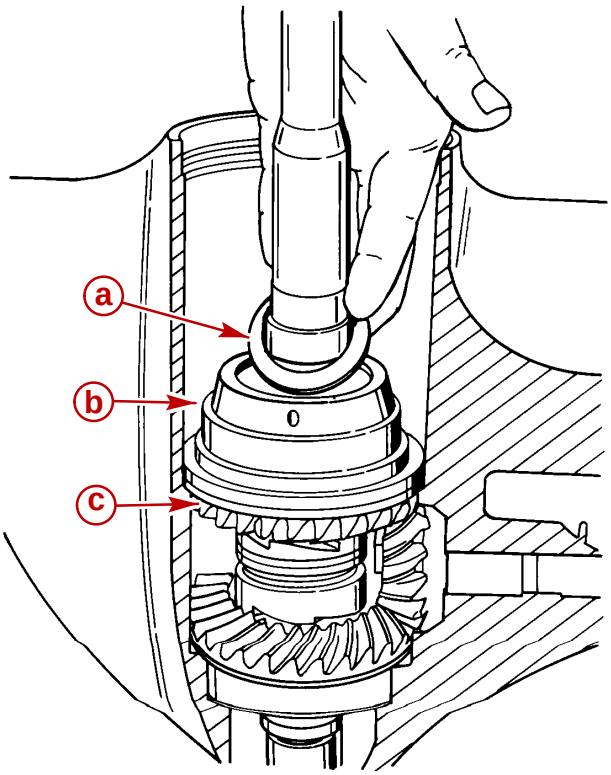
6. Remove the hook tool and, while holding down on the forward gear, remove the forward gear installation tool by holding the bearing adaptor down with a large screwdriver.



50889

a - Forward Gear Installation Tool (91-815850)
b - Forward Gear Bearing Adaptor
c - Forward Gear

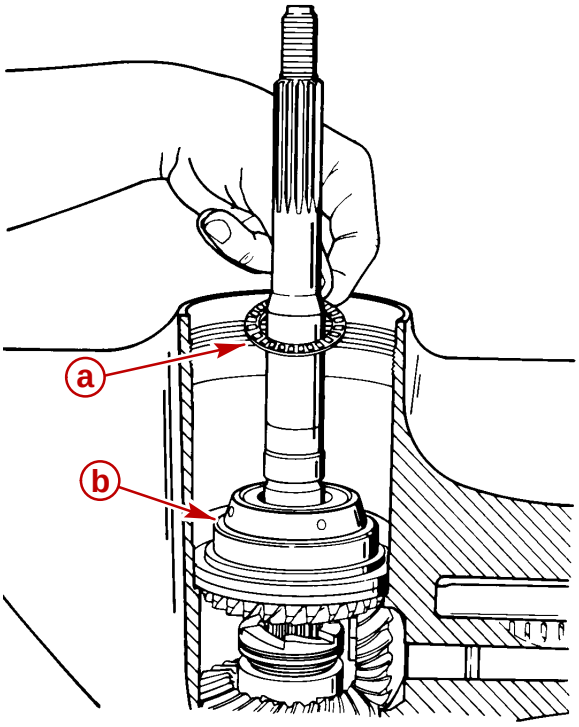
7. Ensure that the top of the bearing adaptor is clean and install the small thrust race on top of the bearing adaptor.



50880

a - Thrust Race
b - Forward Gear Bearing Adaptor
c - Forward Gear

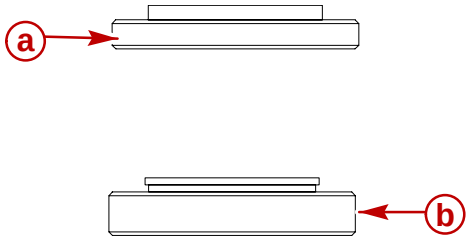
8. Lubricate the small thrust bearing with Quicksilver High Performance Gear Lube and install it on top of the thrust race.



50783

a - Small Thrust Bearing
b - Forward Gear Bearing Adaptor

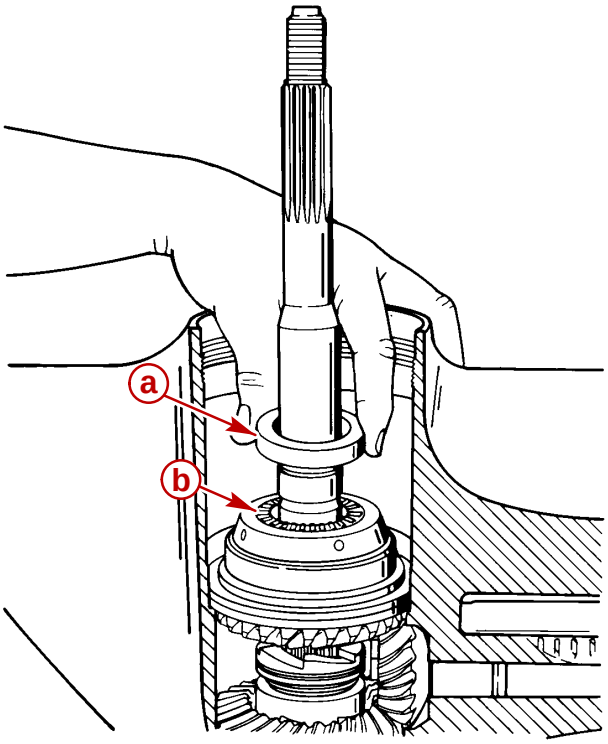
NOTE: *The thrust collars have changed. The later model collars are thinner. See "Special Information" page 3C-8. Do not mix earlier style and later style parts.*



75223

a - Earlier Style Thrust Collar (Prior to S/N OF680000)
b - Later Style Thrust Collar (S/N OF680000 and after)

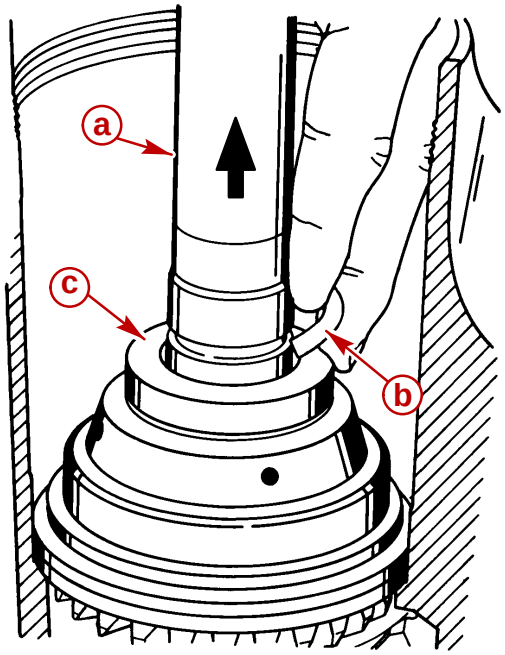
9. Assemble the thrust collar with its stepped side down toward the small thrust bearing.



50784

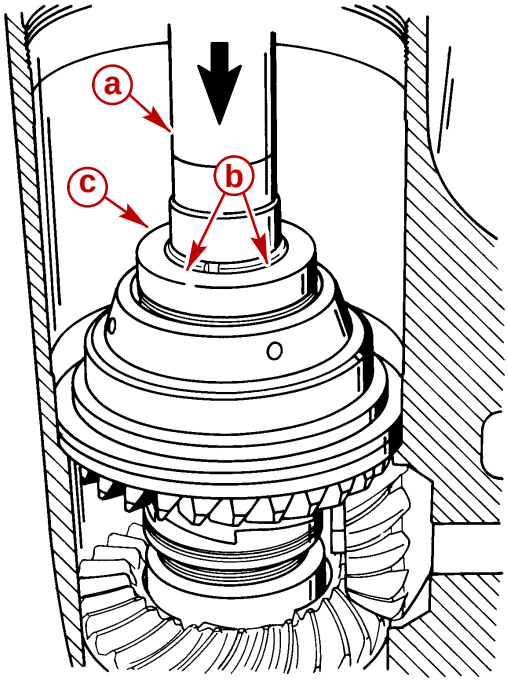
a - Thrust Collar
b - Small Thrust Bearing

10. Pull up slightly on the propeller shaft to gain access to the groove on the shaft for the keepers. Assemble the two keepers into the groove and lower the propeller shaft.



50826

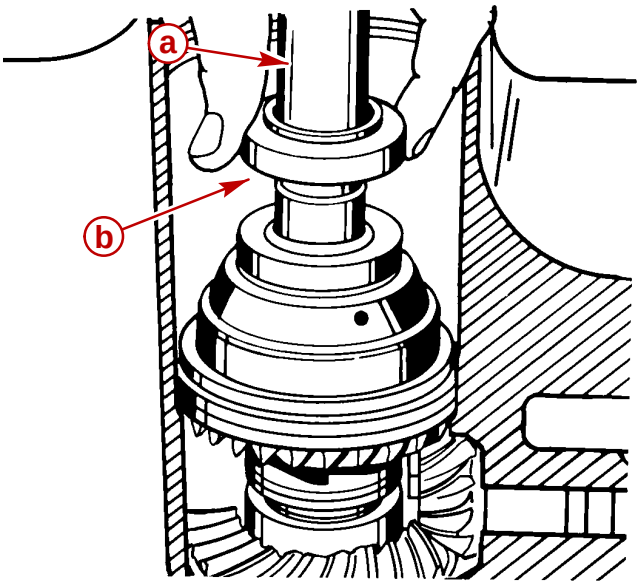
a - Propeller Shaft (Slightly Lifted)
b - Keepers (2)
c - Thrust Collar



50778

a - Propeller Shaft (Lowered Into Position)
b - Keepers
c - Thrust Collar

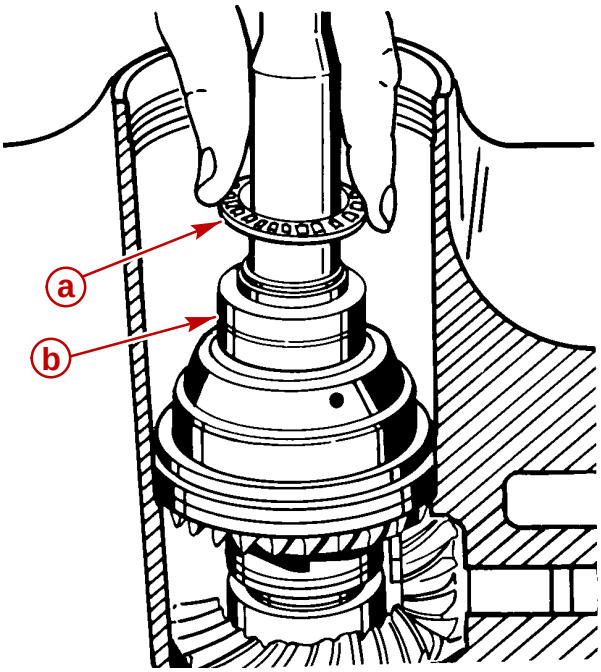
11. Install the second thrust collar with its stepped side up.



50787

a - Propeller Shaft
b - Thrust Collar

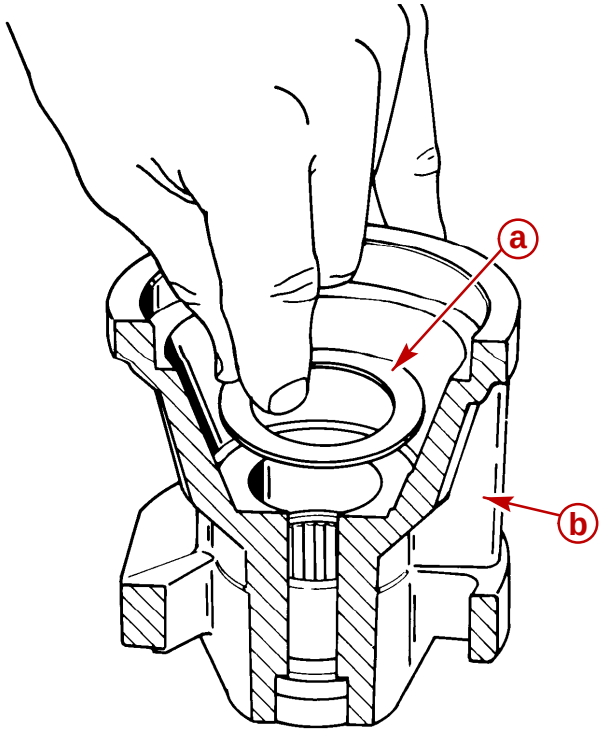
12. Lubricate the second thrust bearing with Quicksilver High Performance Gear Lube and install it to the top of the thrust collar.



50786

a - Thrust Bearing
b - Thrust Collar

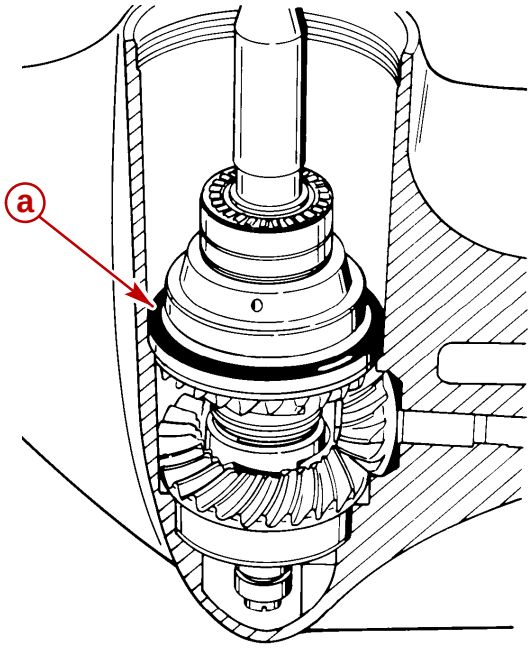
13. Lubricate the second small thrust bearing race with Quicksilver High Performance Gear Lube. Assemble it to the surface inside of the bearing carrier as shown.



50779

a - Thrust Race
b - Bearing Carrier

14. Lubricate the large O-ring with Quicksilver High Performance Gear Lube and assemble into the gear housing as shown following.



50886

a - O-ring

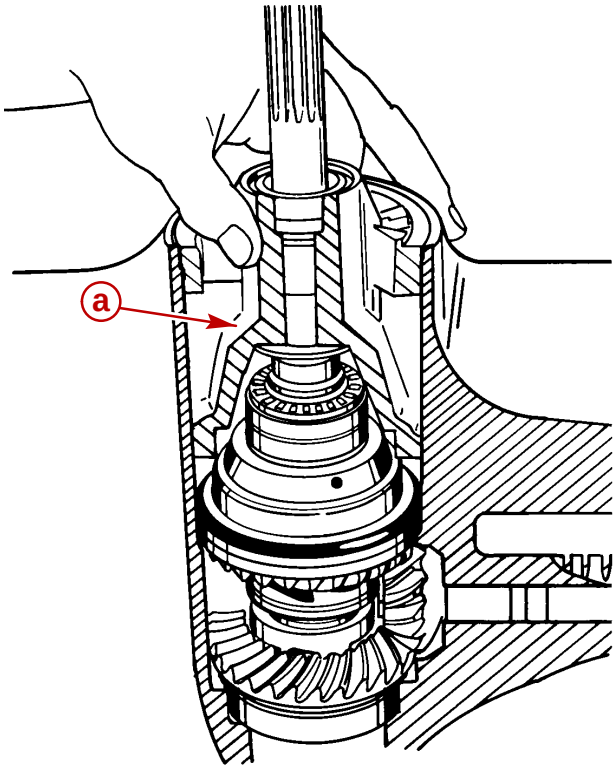
15. Prepare the bearing carrier for installation as follows:

    a. Lubricate the outer diameter of the bearing carrier with Quicksilver Perfect Seal.

b. Fill the space between the carrier oil seals with Quicksilver 2-4-C Marine Lubricant with Teflon.

c. Lubricate the needle bearing with Quicksilver High Performance Gear Lube.

16. Install the bearing carrier assembly into the gear housing.

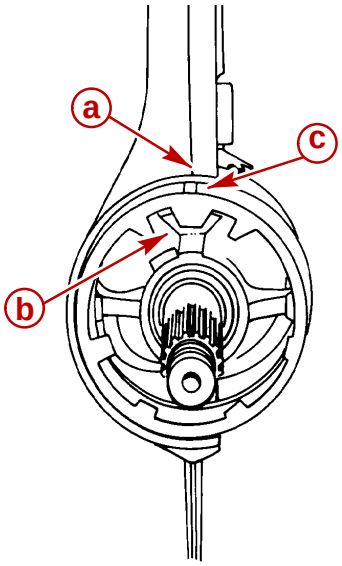


50826

a - Bearing Carrier Assembly

17. Align the bearing carrier “V” shaped notch with the alignment hole in the gear housing.

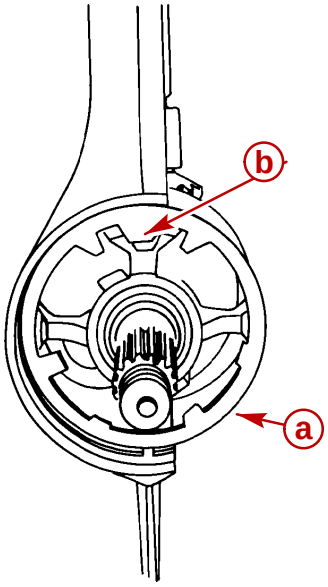
18. Install the tab washer with the external tab inserted into the hole in the gear housing.



70713

a - Gear Case Alignment Hole
b - “V” Shaped Notch in Bearing Carrier
c - Alignment Tab of Tab Washer

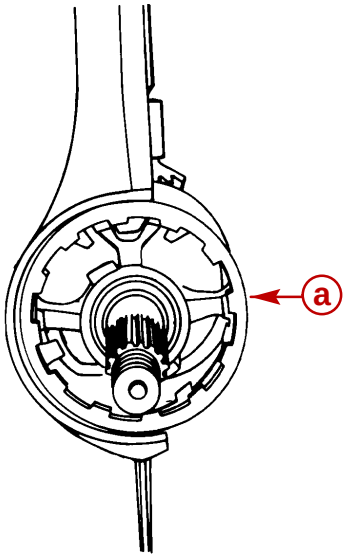
19. Ensure that the “V” shaped tab aligns with the “V” notch in bearing carrier.



70714

a - Tab Washer
b - “V” Tab

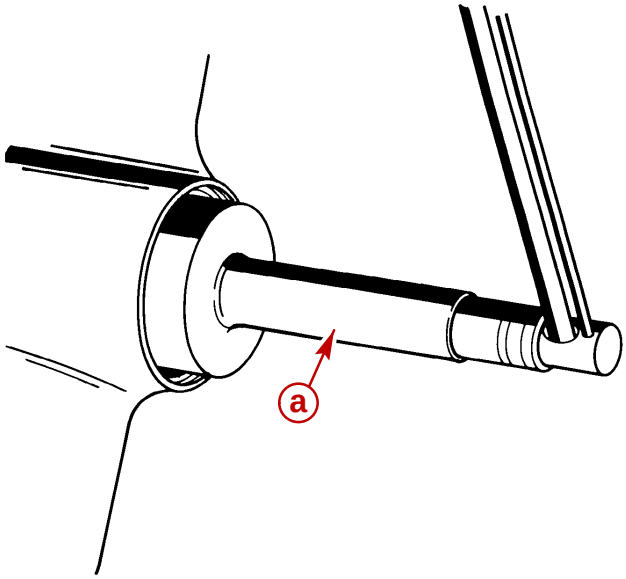
20. Generously lubricate the bearing carrier retainer threads with Quicksilver Lubricant 101. Start the retainer into the gear housing threads with the notched side down and the numbered side up. Screw it down fully by hand.



70715

a - Bearing Carrier Retainer

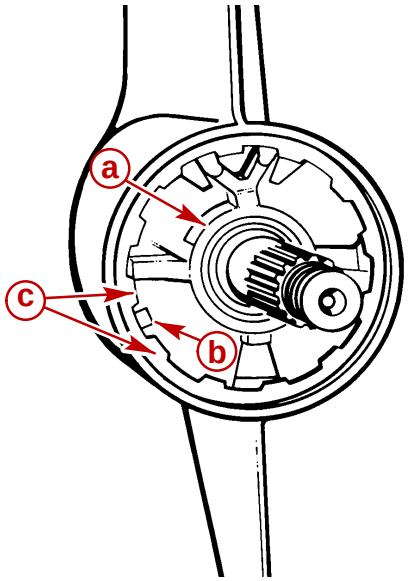
21. Torque the bearing carrier retainer to 210 lb-ft (285 Nm).



23355

a - Bearing Carrier Retainer Wrench (91-61069)

22. Ensure tabs are aligned with notch in retainer nut. Bend one tab aft (outward) into a space between two of the notches of the retainer. Bend all the remaining tabs forward (inward).



70490

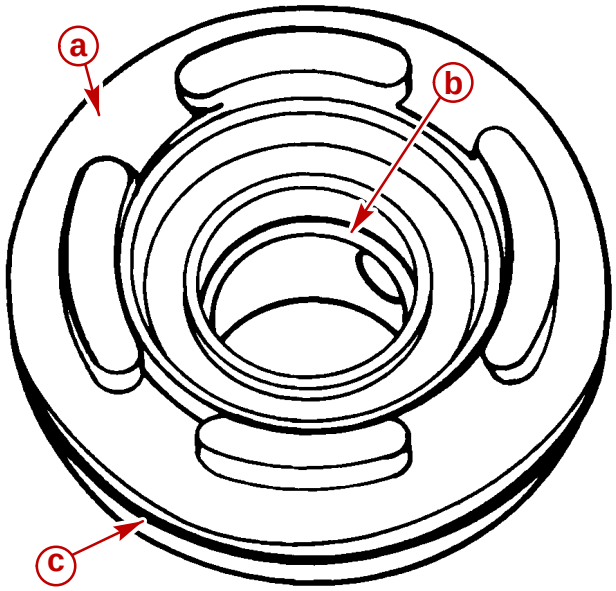
a - Bearing Carrier
b - Tab
c - Retainer Notches

Oil Seal Carrier Assembly

Installation

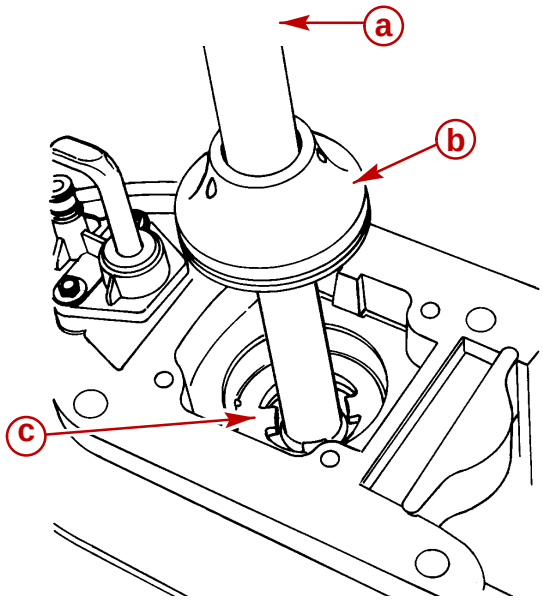
NOTE: *Apply hand pressure only to install the oil seal carrier into position. Do not hammer it into position.*

1. Lubricate the oil seal carrier oil seal lips and O-ring with Quicksilver 2-4-C Marine Lubricant with Teflon and install the oil seal carrier over the drive shaft and into the gear case.



70501

a - Oil Seal Carrier (Bottom View)
b - Oil Seal Lips
c - O-ring



75685

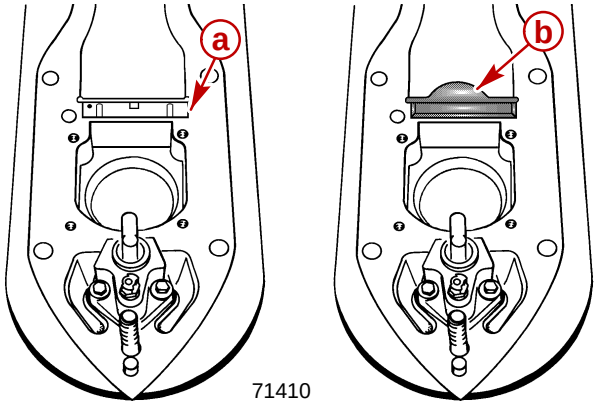
a - Drive Shaft
b - Oil Seal Carrier
c - Retainer Nut

Water Pump Assembly

Installation

NOTE: *The aluminum dam has been changed to a rubber filler plug. If the aluminum water pump dam in the gear housing has become corroded or damaged, it can be replaced with the rubber filler plug.*

1. Install the rubber filler plug or aluminum dam in the gear housing. Earlier models will have an aluminum dam, later models will have a rubber filler plug. To replace the aluminum dam if it has been removed and undamaged, place a bead of Permatex Ultra Blue Silicone Sealant down both sides of it.

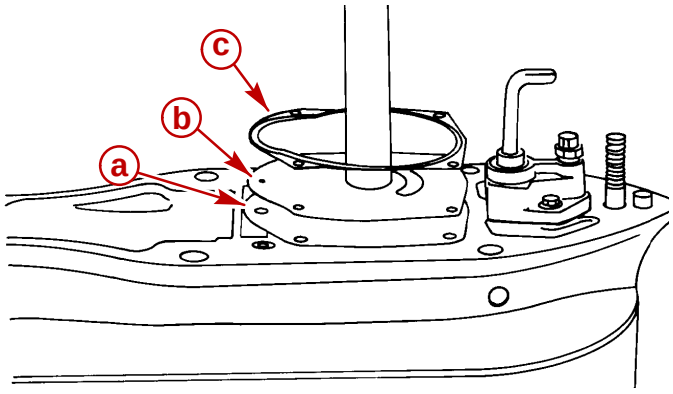


71410 71436

a - Aluminum Dam
b - Rubber Filler Plug

IMPORTANT: The gaskets/face plate hole pattern is not symmetrical. If the holes of the gaskets/face plate do not align with the screw holes of the gear case and/or each other, one or more of the parts is upside down. Determine which part(s) is (are) upside down and turn the appropriate part(s) over.

2. Assemble the small hole gasket then the face plate followed by the large hole gasket onto the gear case.



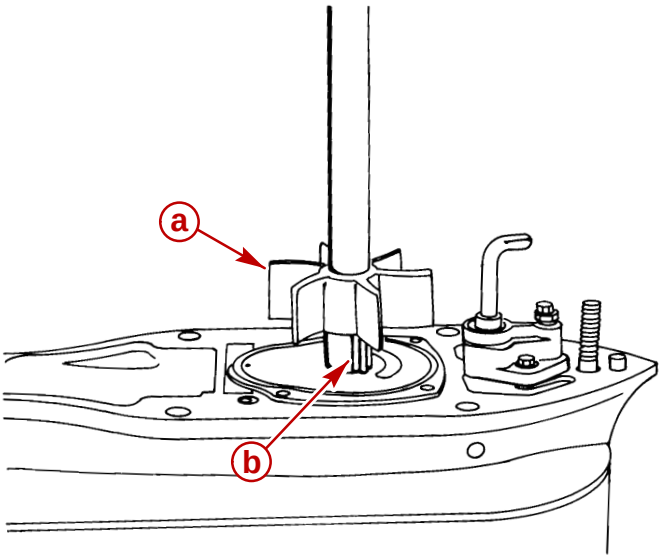
70720

a - Small Hole Gasket
b - Face Plate
c - Large Hole Gasket

3. Place a small amount of Quicksilver 2-4-C Marine Lubricant with Teflon on the flat surface of the impeller key and assemble the key onto the drive shaft keyway.

IMPORTANT: When using an impeller whose blades have taken a set, face the curl of the blades in a counterclockwise direction. DO NOT install the impeller with its blades positioned in a reversed direction from original rotation or premature impeller failure will occur.

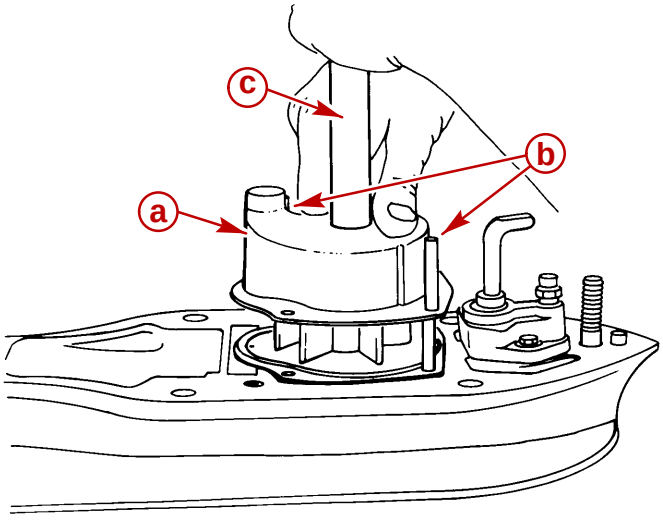
4. Assemble the water pump impeller onto the drive shaft and down over the key.



70721

a - Water Pump Impeller
b - Water Pump Impeller Key

5. Install the two (2) water pump locating pins through the gaskets and face plate.
6. Lightly lubricate the inside of the water housing with Quicksilver 2-4-C Marine Lubricant with Teflon. Position the water pump body over the drive shaft and water pump locating pins. Rotate the drive shaft in a clockwise direction, while pushing down on the water pump body to ease the water pump over the impeller blades.



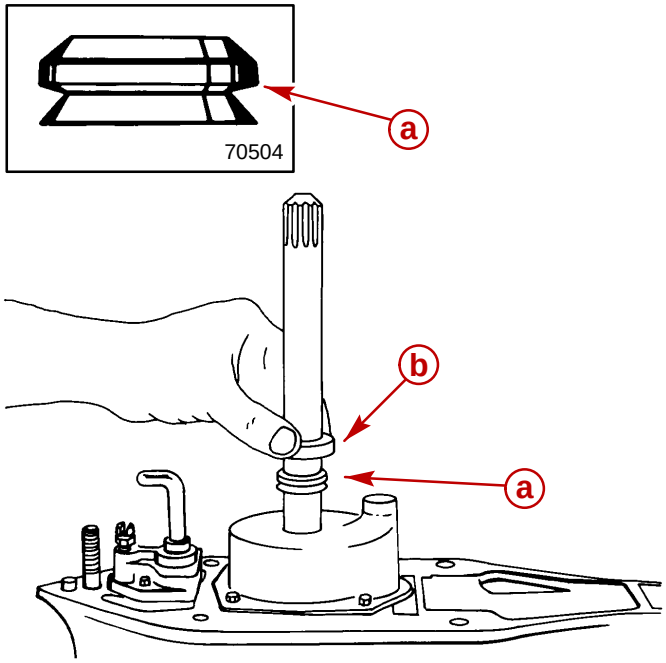
70722

a - Water Pump Body
b - Water Pump Alignment Pins (91-821571A1)
c - Drive Shaft (Turn Clockwise While Installing Water Pump Body)

7. Hand start two (2) fasteners into the water pump assembly and remove the water pump locating pins. Assemble the remaining two (2) fasteners. Run all fasteners down and torque to 60 lb-in. (7.9 Nm).

IMPORTANT: The water pump face seal must be installed as outlined below. Improperly installing the water pump face seal may result in premature failure of the unit.

8. Lightly lubricate the drive shaft with Quicksilver 2-4-C Marine Lubricant with Teflon. Assemble the water pump face seal to a position approximately 1/2 of the way down the drive shaft. Assemble the water pump face seal setting tool over the drive shaft and push the seal down onto the water pump with the tool while pulling up on the drive shaft. Remove the tool from the drive shaft.



70708

a - Water Pump Face Seal
b - Water Pump Face Seal Setting Tool

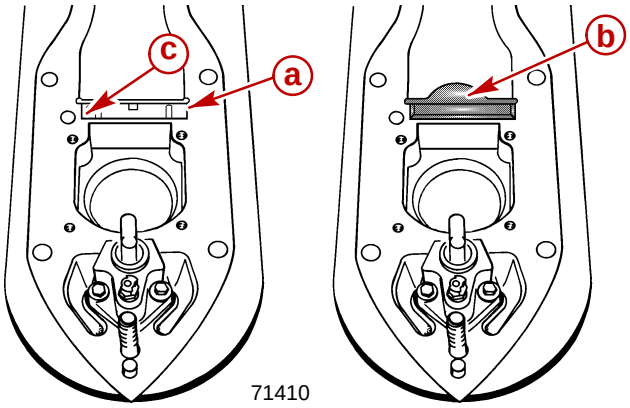
9. Assemble the water tube sleeve into the water tube coupling.
10. Assemble the water tube coupling assembly to the water pump ensuring that the O-rings are not damaged during assembly.

Joining Drive Shaft Housing/Gear Housing

1. Lubricate the end of the water tube (in the drive shaft housing) and the splines of the drive shaft with Quicksilver 2-4-C Marine Lubricant with Teflon .

NOTE: *The aluminum dam has been changed to a rubber filler plug. If the aluminum water pump dam in the gear housing has become corroded or damaged, it can be replaced with the rubber filler plug.*

IMPORTANT: Ensure that the drain hole of the aluminum water pump dam is not clogged with any foreign material as damage may occur if it is.



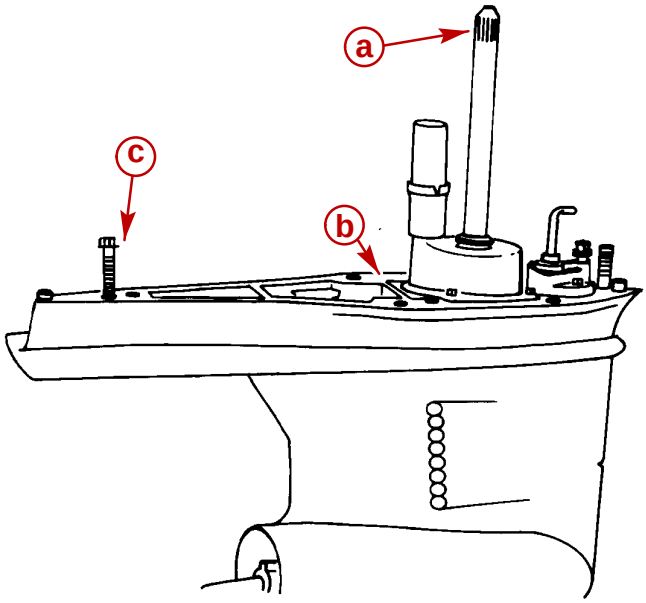
71410 71436

Shown Without Water Pump Assembly For Visual Clarity

- **a** - Aluminum Dam
- **b** - Rubber Filler Plug
- **c** - Drain Hole

2. Units with an aluminum dam installed in them will require a bead of Permatex Ultra Blue Silicone Sealant along the top of the water pump dam as shown. If rubber filler plug is present, it is not necessary to use this sealant.
3. To replace the aluminum dam if it has been removed and undamaged, place a bead of Permatex Ultra Blue Silicone Sealant down both sides of it.

4. Ensure that the water pump dam in the drive shaft housing is present and installed correctly. Ensure that all parts are present on the gear housing and the drive shaft housing.

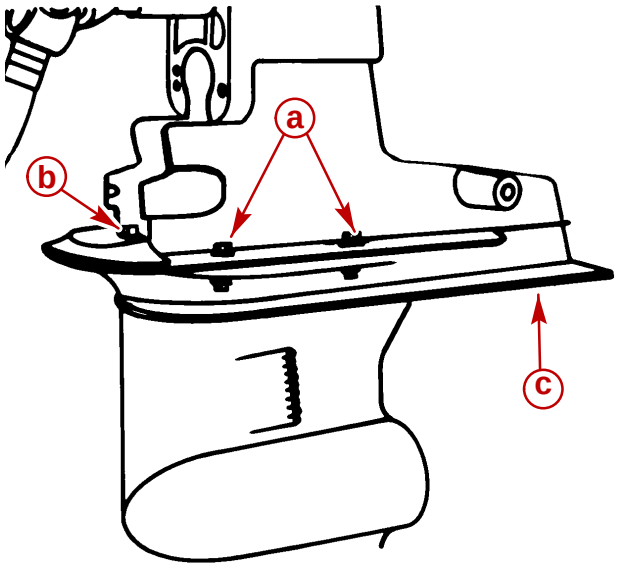


70710

a - Drive Shaft Splines
b - Sealant - Aluminum Dam Only
c - Trim Tab Bolt (Insert In Aft Hole)

5. Install trim tab screw.
6. Position the drive shaft housing straight above the gear housing. Align the water tube sleeve with the water tube and the drive shaft with the upper drive gear. Assemble the drive shaft housing to the gear housing. It may be necessary to rotate the propeller shaft or the u-joint to align the drive shaft splines with the upper drive gear splines.
7. Assemble the front nut to the front stud of the unit.
8. Assemble the aft screw with the continuity (star) washer (into the forward hole in the trim tab well of the gear housing).
9. Assemble the bolts, nuts and washers to the port and starboard sides of the unit.

NOTE: *Torque all fasteners as listed in the following figure.*



70117

a - Nuts, Bolts, Washers [Torque To 35 lb-ft [47.5 Nm)]
b - Nut [Torque To 35 lb-ft [47.5 Nm)]
c - Screw [Torque To 28 lb-ft [41 Nm)]

10. Assemble the trim tab and align it to the mark made previously on the gear housing. Torque the screw to 23 lb-ft (31 Nm).
11. Position or lower drive unit so anti-ventilation plate is level.
12. Refill drive unit with gear lube. Refer to Section 1B.

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TRANSOM ASSEMBLY

Section 4A - Service Procedures Requiring Minor Disassembly

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4 A

Specifications

Torque Specifications

Description	Torque		
	lb-in.	lb-ft	Nm
Shift Cable Core Wire Anchor Screws	20		2.3
Bellows Hose Clamps	35		4
Hinge Pins		102	143

Lubricants/Sealers/Adhesives

Description	Part Number
3M Brand Adhesive	92-86166Q1
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12

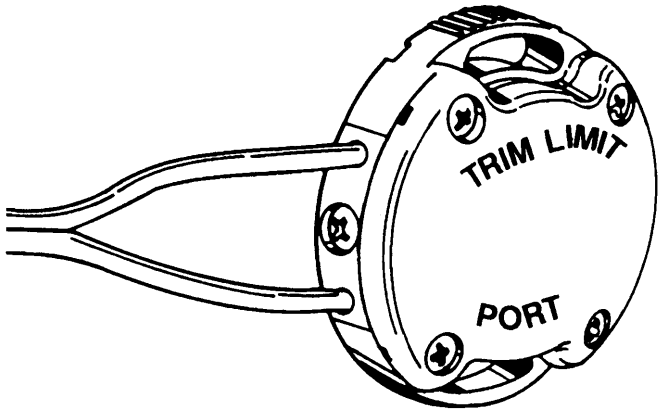
Special Tools

Description	Part Number
Bearing Removal and Installation Tool	91-31229A7
Bellows Expander Tool	91-45497A1
Slide Hammer Puller	91-34569A1
Shift Cable Removal and Installation Tool	91-12037
Hinge Pin Tool	91-78310
Sleeve Removal Tool (U-joint Bellows)	91-818169T
Sleeve Installation Tool (U-joint Bellows)	91-818162

Special Information

Trim Limit Switch

The trim limit switch has a sealing system for improved water resistance and durability. The trim limit switch leads are connected internally to help ensure good electrical integrity.

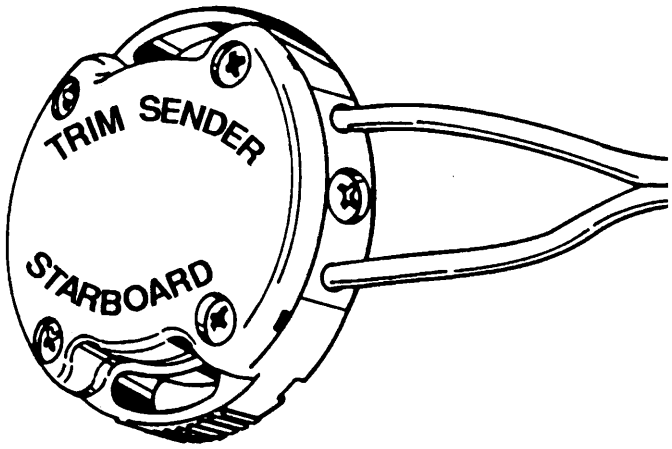


71415

Trim Limit Switch – Port

Trim Position Sender

The trim position sender has a sealing system for improved water resistance and durability. The trim limit leads are connected internally to help ensure good electrical integrity.



71414

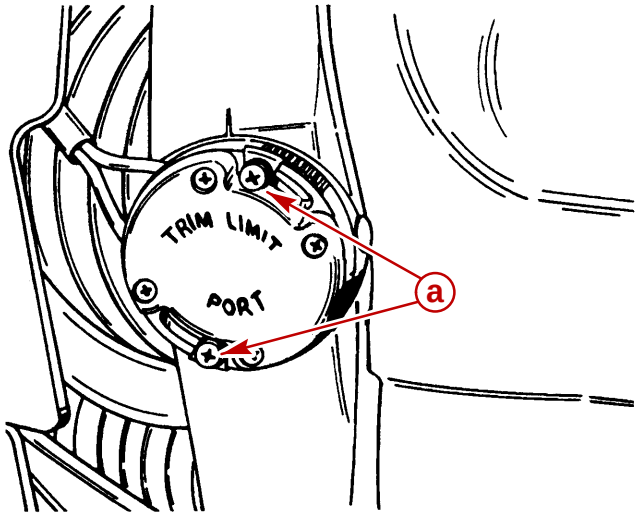
Trim Position Sender – Starboard

Trim Limit Switch and Trim Position Sender

Removal

NOTE: *Disconnect both the trim limit and trim sender leads before removing.*

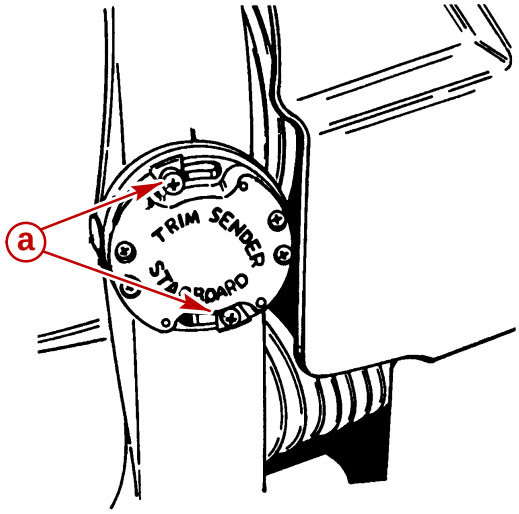
1. Remove sterndrive unit.
2. Remove trim limit switch.



71221

a - Screws, Washers And Retainers

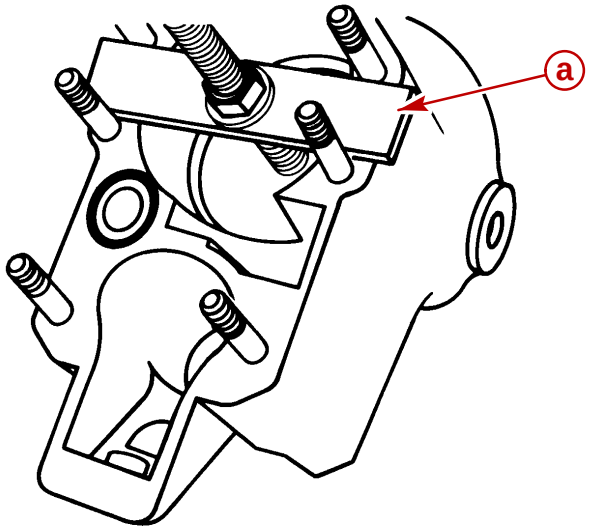
3. Remove trim position sender.



71220

a - Screws, Washers and Retainers

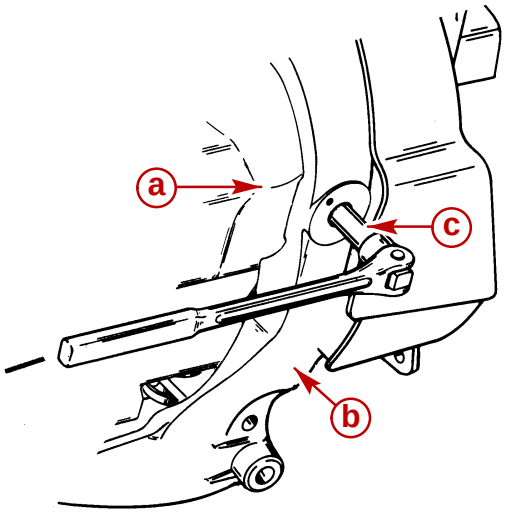
4. Remove U-joint bellows sleeve.



70178

a - Sleeve Removal Tool (91-818169)

5. Remove both hinge pins.

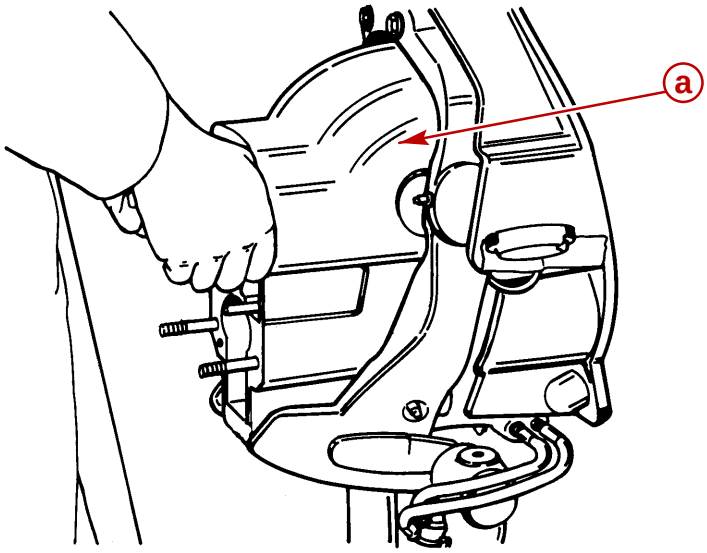


22113

a - Bell Housing
b - Gimbal Ring
c - Hinge Pin Tool (91-78310)

6. Remove bellows from bell housing.

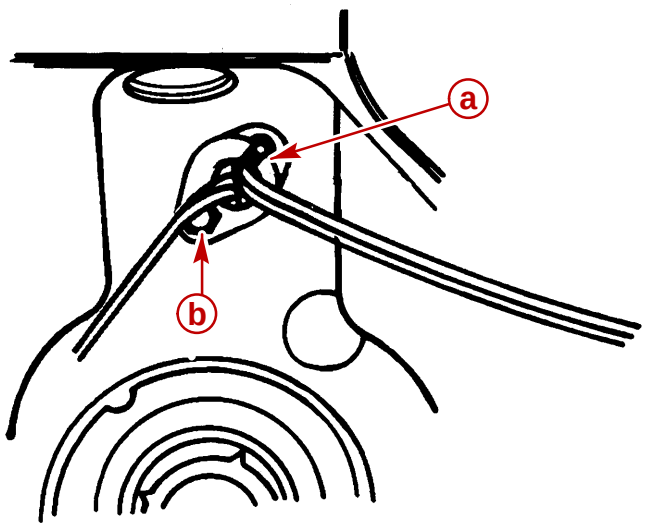
7. Pull back on bell housing and rotate it 90 degrees to gain access to the trim wire retainer screw.



23363

a - Bell Housing

8. Remove trim wire retainer.



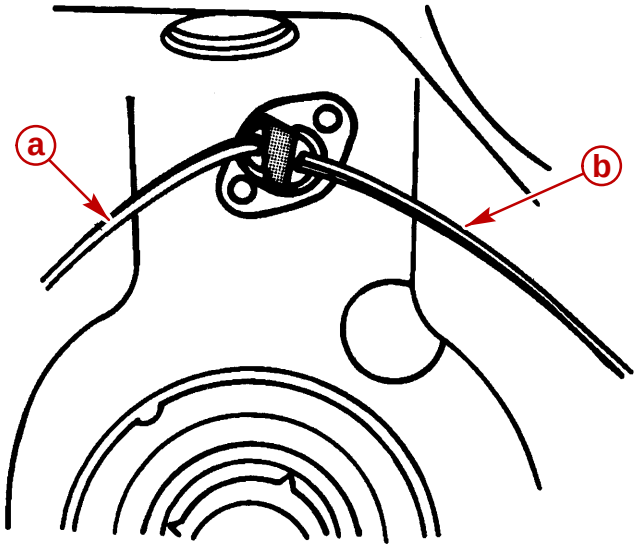
70197

a - Clamp
b - Belt Screw

9. Remove trim sender and trim limit wires from gimbal housing.

Installation

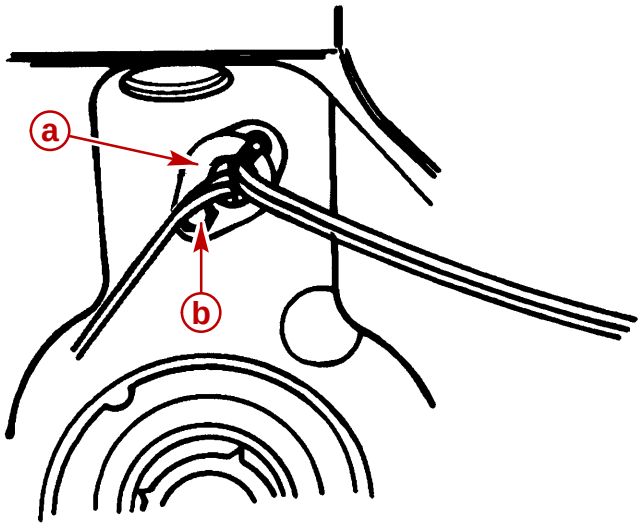
1. Route the new sender wires through the hole. Bring the two grommet halves together and ensure they are seated lightly in the hole and that the flat edges that mate together are vertically aligned. Maintain light tension on the wires from inside the boat, to hold the grommets in the hole.



70198

a - Trim Limit Switch Wires
b - Trim Position Sender Wires

2. Reinstall retainer and torque screw to 95 lb-in. (10.8 Nm).

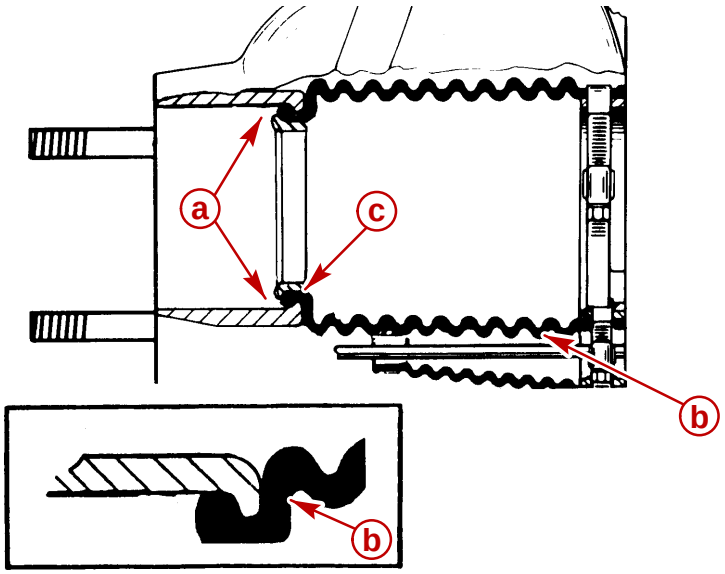


70197

a - Clamp
b - Screw

3. Connect U-joint bellows to bell housing as follows:

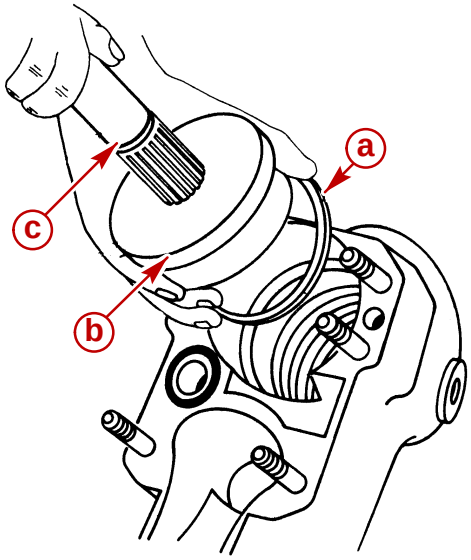
   a. Position U-joint bellows on bell housing. Ensure that the bell housing flange rests in the groove at the end of bellows.



75268

a - Bell Housing Flange
b - Bellows
c - Groove

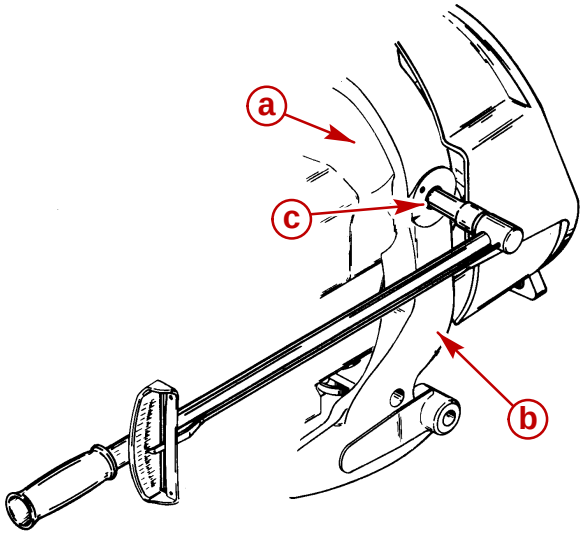
   b. Lubricate sleeve O.D. with engine cleaner (Quicksilver Power Tune works well and it evaporates quickly) and install sleeve with tool and suitable driving rod.



70207

a - Sleeve
b - Installation Tool (91-818162)
c - Suitable Driving Rod

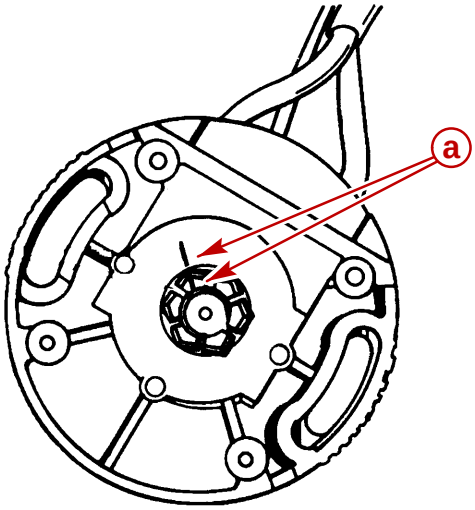
4. Apply Locquic Primer “T” to internal bell housing threads and external hinge pin threads and allow to dry. Apply Loctite 8831 or 271 to bell housing threads and install hinge pins. Torque hinge pins to 100 lb-ft (136 Nm).



23292

a - Bell Housing
b - Gimbal Ring
c - Hinge Pin Tool (91-78310)

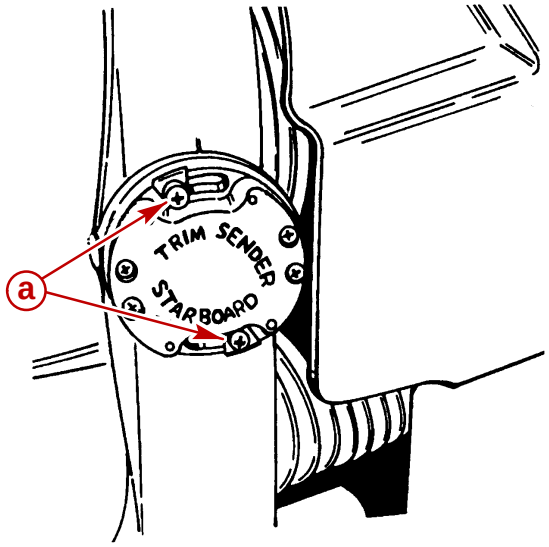
5. Reinstall trim position sender as follows:
   a. Place sterndrive unit in the full DOWN/IN position.
   b. Turn center rotor to align index mark on rotor with index mark on sender body.



71218

a - Index Marks

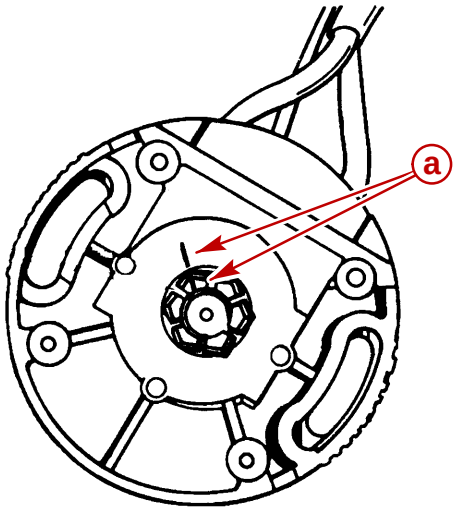
c. Install trim position sender and secure with attaching hardware.



71220

a - Screws, Washers And Retainers

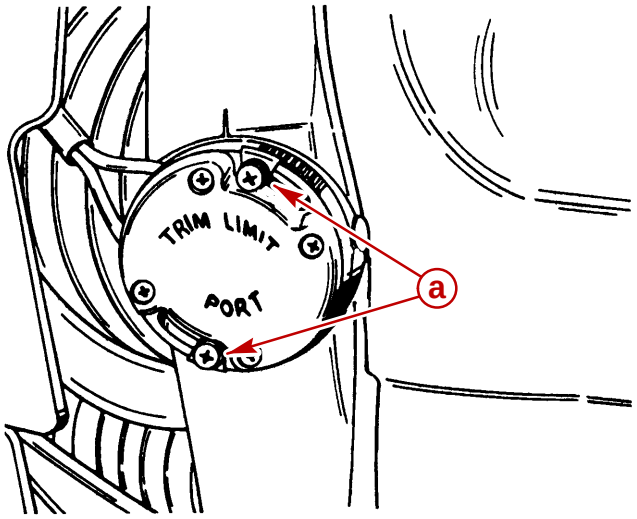
6. Tighten trim position sender retaining screws.
7. Reinstall trim limit switch as follows:
   a. Place drive unit in full DOWN/IN position.
   b. Turn center rotor to align index mark on rotor with index mark on sender body.



71218

a - Index Marks

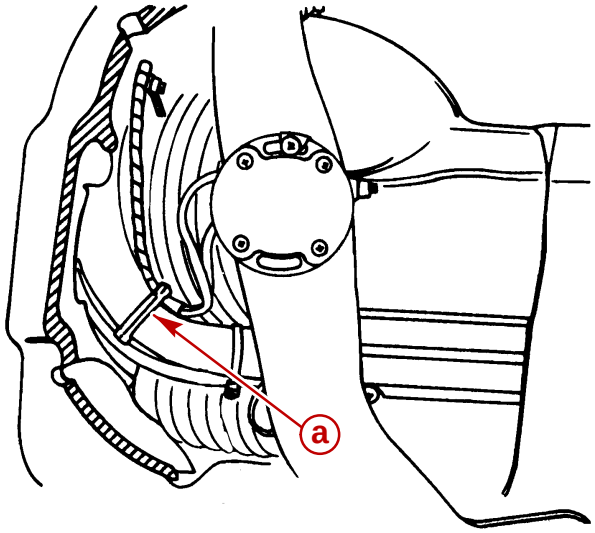
c. Install trim limit switch and secure with attaching hardware.



71221

a - Screws, Washers And Retainers

8. Secure the trim limit switch harness to the water hose with the plastic clip shown in figure below.

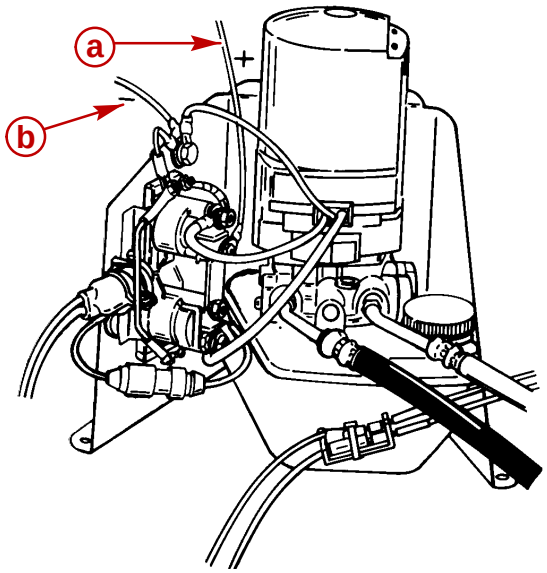


71184

a - Plastic Clip

Trim Position Sender Adjustment

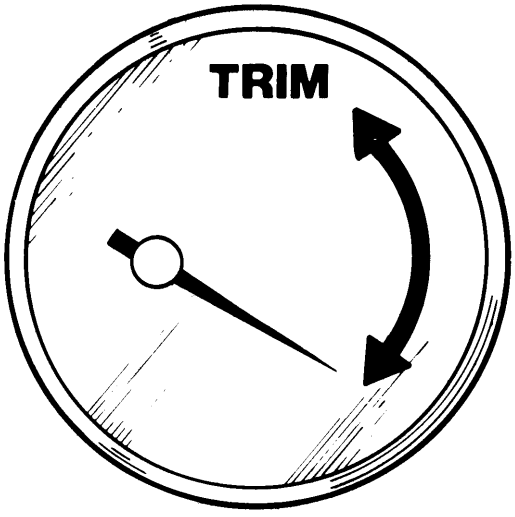
1. Reconnect trim position sender wires to engine harness and trim limit switch leads to trim pump harness.
2. Reinstall battery cables.



22031

a - Positive Battery Lead (-)
b - Negative Battery Lead (+)

3. Turn ignition key to the “RUN” position. DO NOT START ENGINE with the drive unit in the DOWN/IN position. Rotate sender until needle is at bottom mark on the gauge. Retighten screws when adjustment is correct.



22175

Trim Limit Switch Adjustment

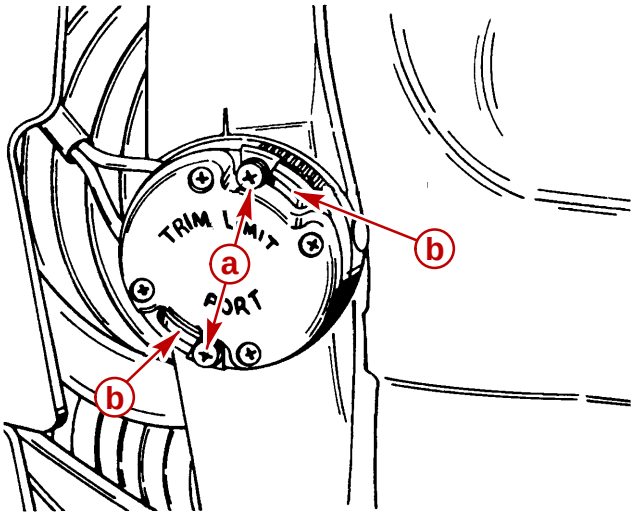
⚠ WARNING

When adjusting trim limit switch, use extreme care that the engine is not started and keep clear of the area near the propeller. Use care to prevent placing hands in an area where injury could occur because of drive unit movement.

⚠ CAUTION

Trim limit switch MUST BE adjusted exactly as outlined. If switch is adjusted incorrectly, drive unit could move out beyond the gimbal ring support flanges and cause damage to sterndrive unit.

1. Adjust trim limit switch as follows:
   a. Loosen screws and turn trim limit switch clockwise to end of slots.

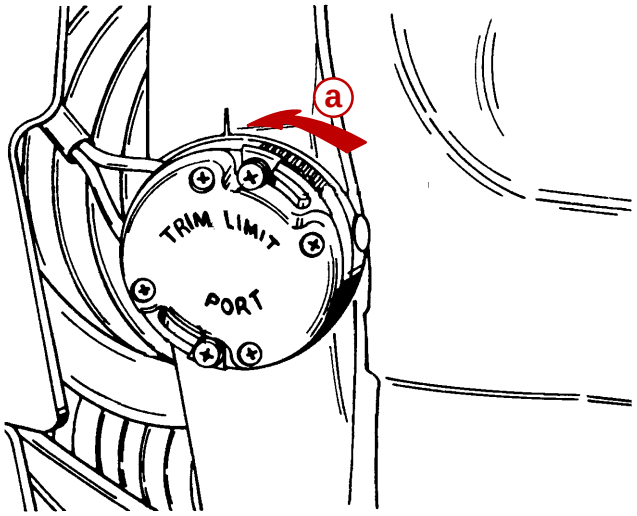


71221

a - Screws
b - Slots

   b. Ensure drive unit is in the full DOWN/IN position.
   c. Using the Trim button on the control, trim drive unit UP/OUT. DO NOT USE TRAILER BUTTON.

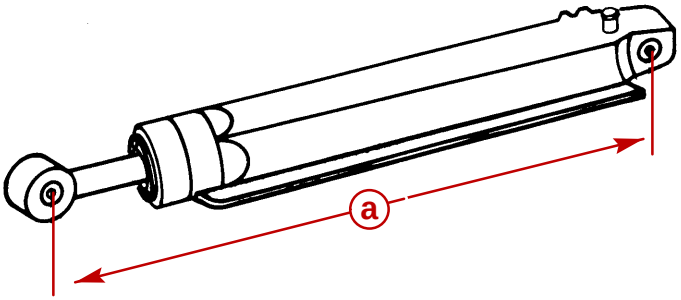
d. Slowly turn trim limit switch counterclockwise until trim cylinders extend to dimension shown (Refer to illustration below.)



71221

a - Rotate Counterclockwise To Adjust

e. Retighten screws when adjustment is correct.



70136

a - 20-3/4 in. Maximum (520 mm)

Gimbal Bearing

IMPORTANT: Gimbal bearing and carrier are a matched set and must be replaced as an assembly. Tolerance ring must be replaced anytime gimbal bearing is removed.

Inspection

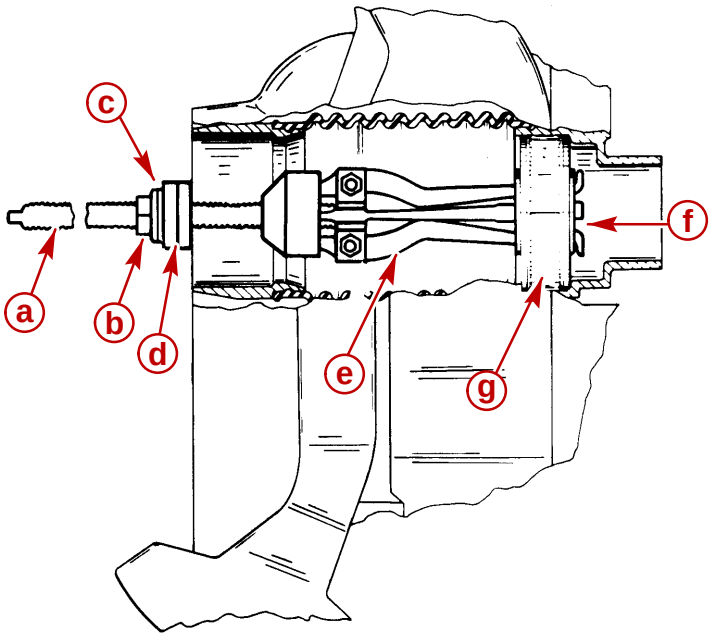
1. Remove sterndrive unit.
2. Reach through bell housing and rotate gimbal bearing to check for rough spots. Push and pull on inner race to check for side wear. Any excessive movement or roughness is cause for replacement.

Removal

⚠ CAUTION

Do not remove gimbal bearing unless replacement is necessary, as damage to bearing may result during removal.

1. Remove gimbal bearing assembly using tools as shown.

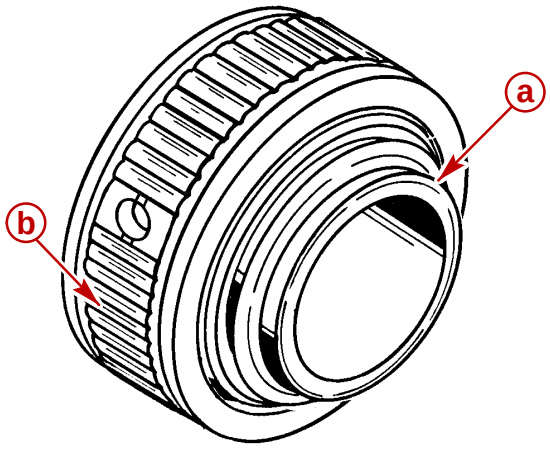


23151

- **a** - Puller Shaft (91-31229)*
- **b** - Nut (11-24156)*
- **c** - Washer (12-34961)*
- **d** - Plates (2) (91-29310)*
- **e** - Slide Hammer Puller
- **f** - Gimbal Bearing Inner Race
- **g** - Gimbal Bearing Carrier

* From Bearing Removal and Installation Tool 91-31229A5

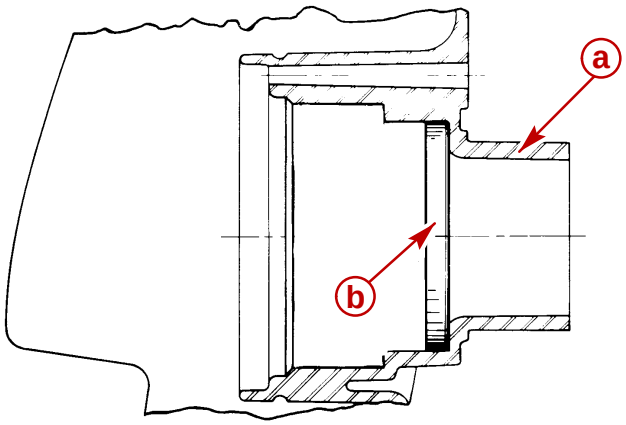
2. Remove tolerance ring.



75214

a - Gimbal Bearing Carrier
b - Tolerance Ring

3. Remove grease seal.

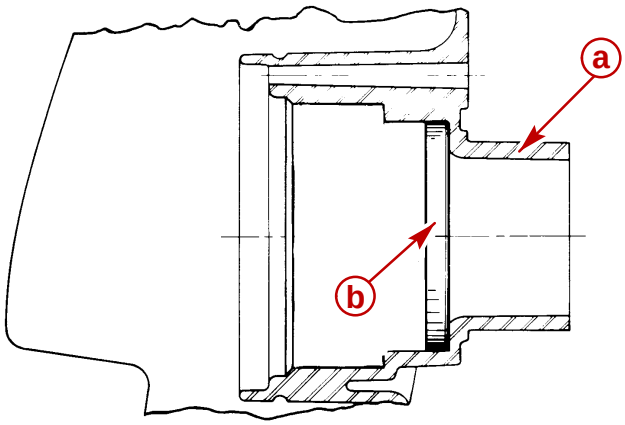


22171

a - Gimbal Housing
b - Grease Seal

Installation

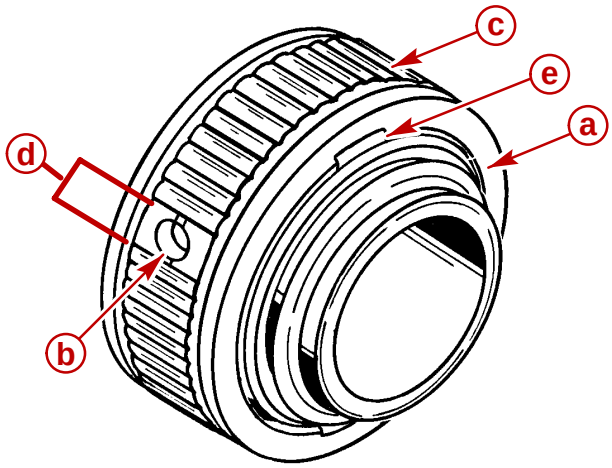
1. Install new grease seal to position shown in illustration below using a suitable mandrel.



22171

a - Gimbal Housing
b - Grease Seal

2. Install and position new tolerance ring, as shown.

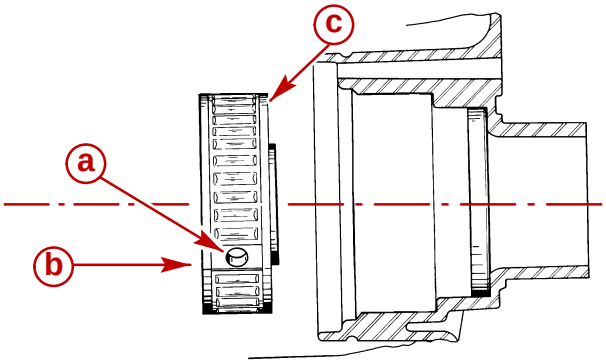


22159

a - Carrier
b - Carrier Grease Hole
c - Tolerance Ring
d - Align Opening In Tolerance Ring With Grease Hole In Carrier
e - Notched Edge Of Bearing Carrier

3. Ensure that notched edge of bearing carrier faces inward in bore when installing gimbal bearing.

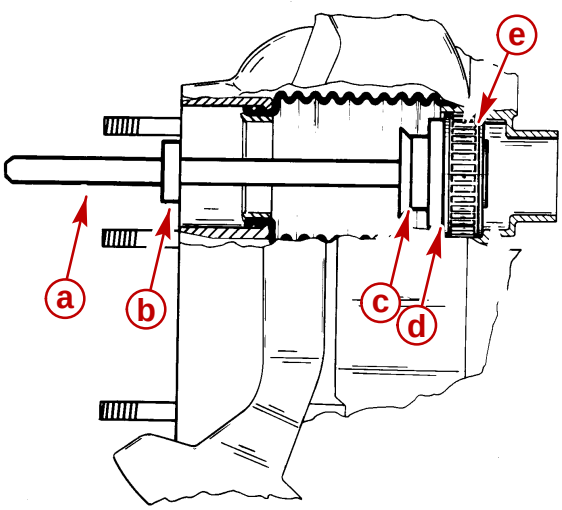
4. Align gimbal bearing carrier grease hole and tolerance ring opening with grease cavity hole in gimbal housing.



77020

a - Gimbal Bearing Carrier Grease Hole
b - Tolerance Ring Opening
c - Bearing Carrier Notch - Face Inward

5. Install gimbal bearing with tools, as shown. Tap in with a lead hammer until carrier rests on the gimbal housing. Approximately 1/8 in. of the bore will show when the bearing is bottomed out.



22118

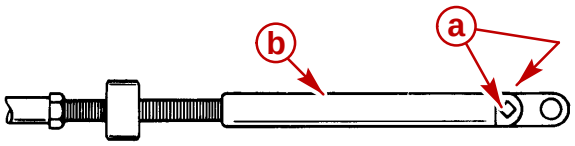
a - Driver Rod (91-37323)*
b - Plate (91-29310)*
c - Driver Head (91-32325)*
d - Mandrel (91-30366-1)*
e - Gimbal Bearing Assembly

* From Bearing Removal and Installation Tool 91-31229A7

Shift Cable

Removal

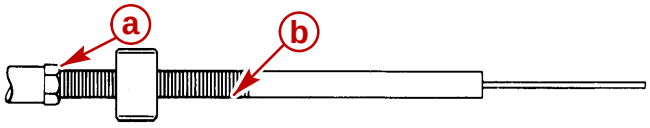
1. Remove sterndrive unit.
2. Disconnect shift cable from shift plate and remove end guide.



22183

a - Anchor Screws (2)
b - End Guide

3. Remove threaded tube.

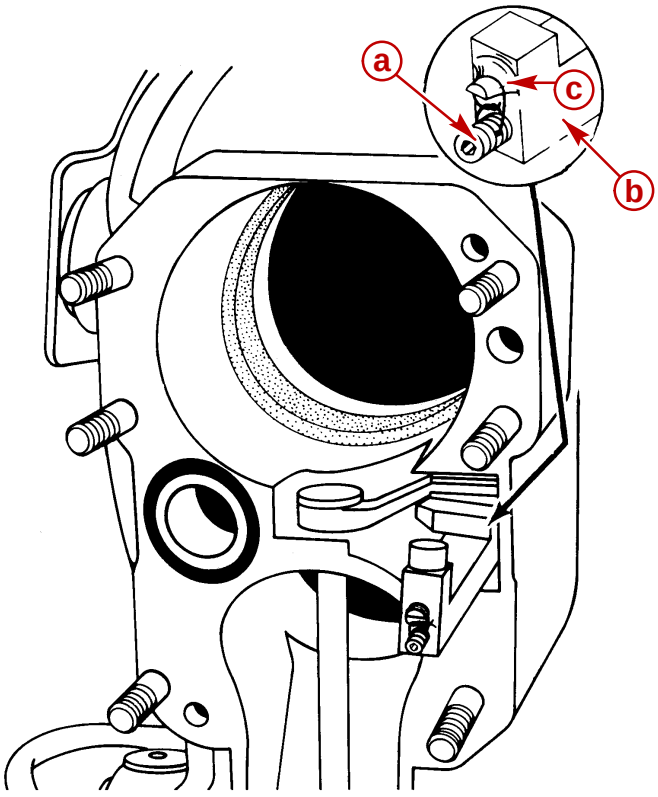


22183

a - Jam Nut
b - Threaded Tube

22183

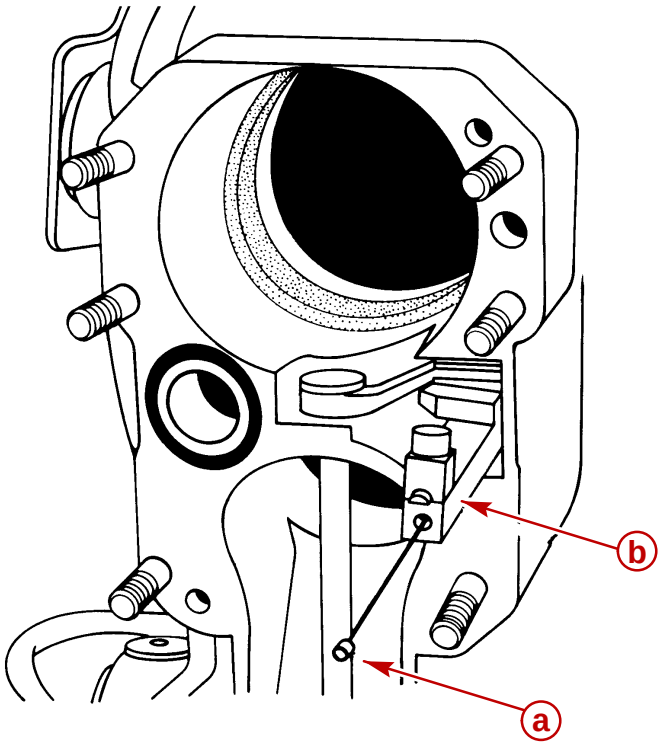
4. Cut safety wire and remove set screw from shift slide.



70138

a - Set Screw
b - Shift Slide
c - Safety Wire

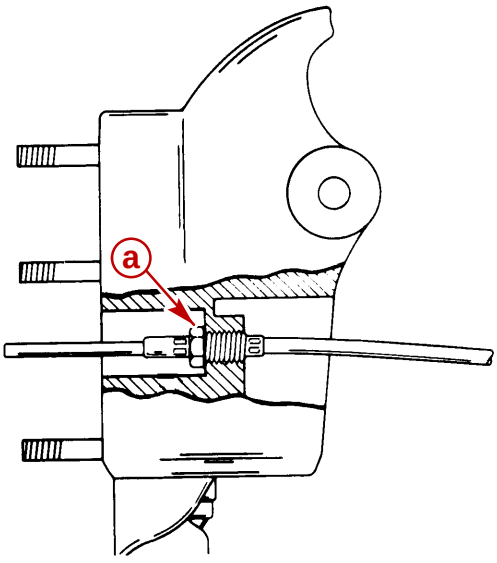
5. Remove inner core wire and shift slide.



70138

a - Inner Core Wire
b - Shift Slide

6. Using shift cable removal and installation tool (91-12037), completely loosen shift cable retaining nut.

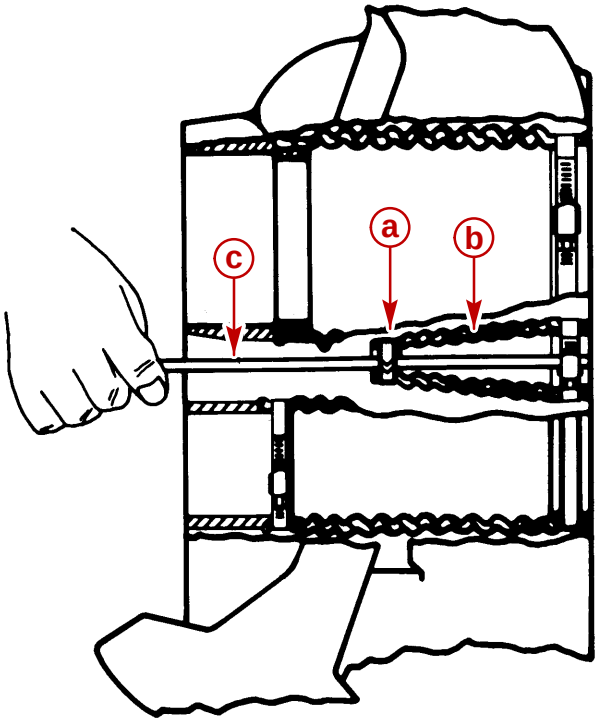


23156

a - Shift Cable Retaining Nut

IMPORTANT: The shift cable should be replaced as an assembly only.

7. Loosen and remove shift cable bellows crimp clamp.

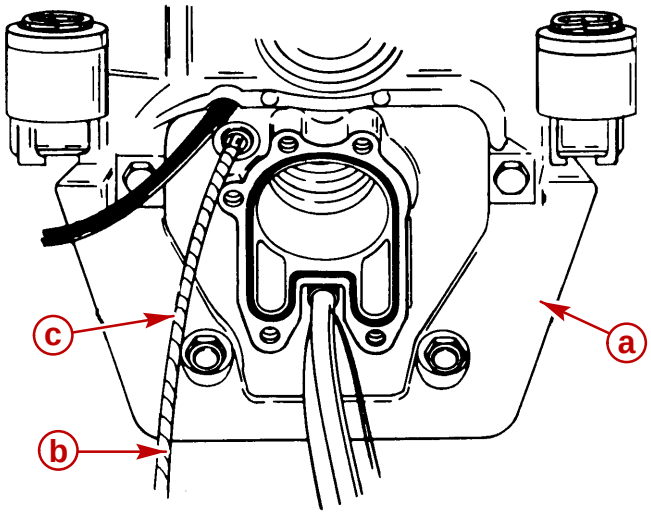


70137

a - Crimp Clamp
b - Shift Cable Bellows
c - Shift Cable

70138

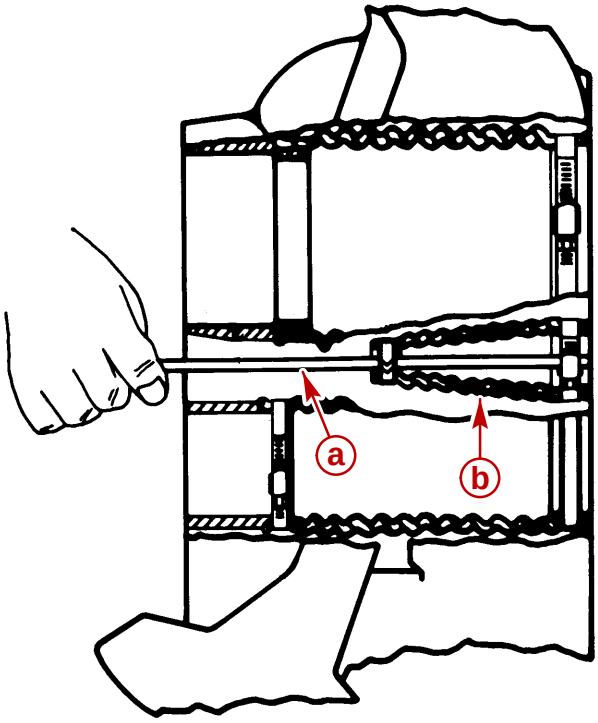
8. Remove shift cable wrapping from shift cable on inner transom.



22030

a - Inner Transom
b - Shift Cable
c - Wrapping

9. Pull shift cable through shift cable bellows.



70137

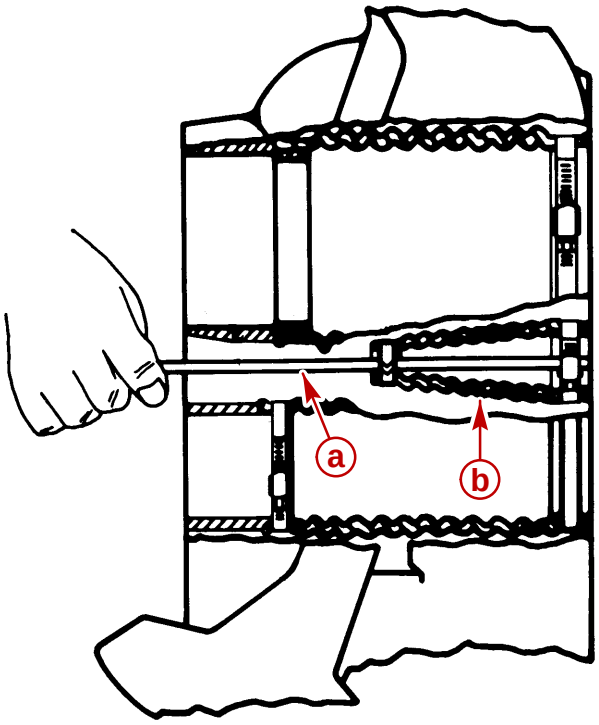
a - Shift Cable
b - Shift Cable Bellows

Inspection

1. Inspect shift cable for cuts, kinks and chafing.
2. Inspect inner core wire for kinks and unraveling.
3. Inspect shift cable retainer nut threads for damage.
4. Inspect for signs of retainer nut separating from outer casing.

Installation

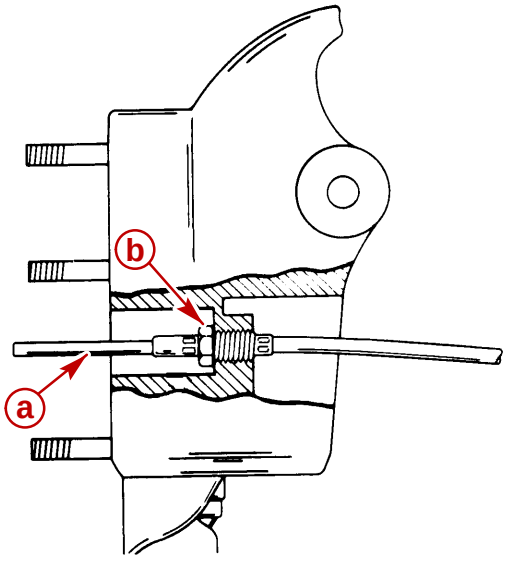
1. Insert shift cable through bell housing and shift cable bellows.



70137

a - Shift Cable
b - Shift Cable Bellows

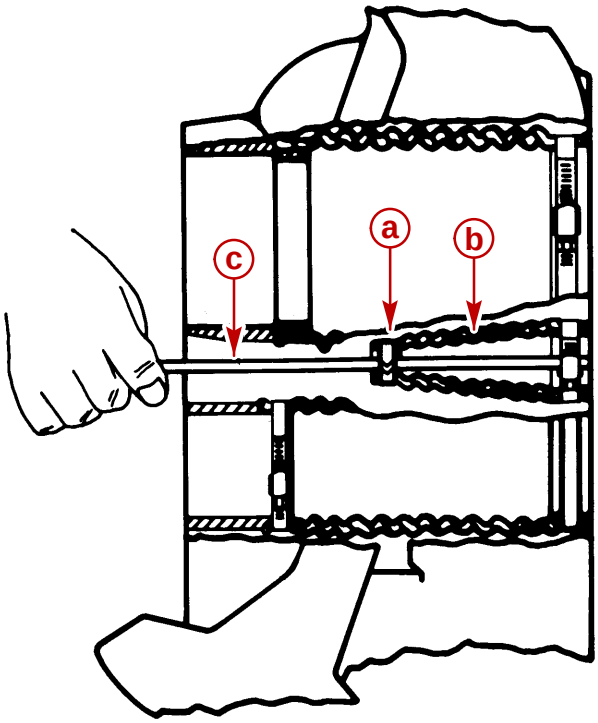
2. Apply Perfect Seal to shift cable retainer nut threads and secure shift cable to bell housing, using shift cable removal and installation tool (91-12037). **No more than 2 threads on retainer nut should be exposed.**



23156

a - Shift Cable
b - Retainer Nut

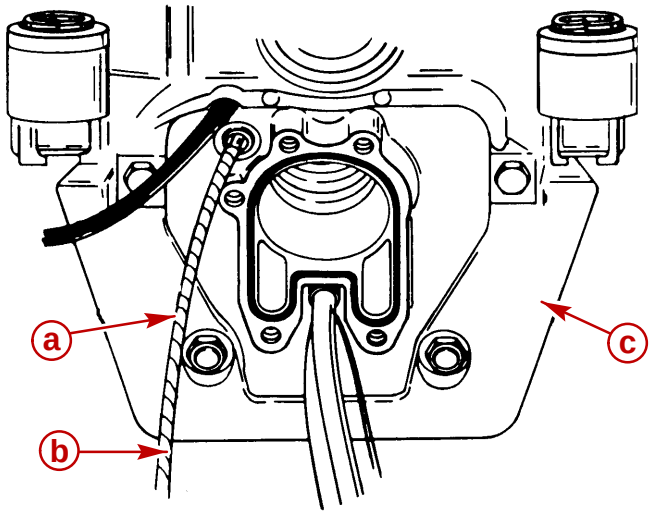
3. Install and compress shift cable bellows crimp clamp. Be sure that clamp is crimped evenly so that a good seal is maintained between bellows and shift cable. (Plans for Crimp Clamp Tool are on p. 4A-26) DO NOT allow bellows to flatten or water leak may occur.



70137

a - Crimp Clamp
b - Shift Cable Bellows
c - Shift Cable

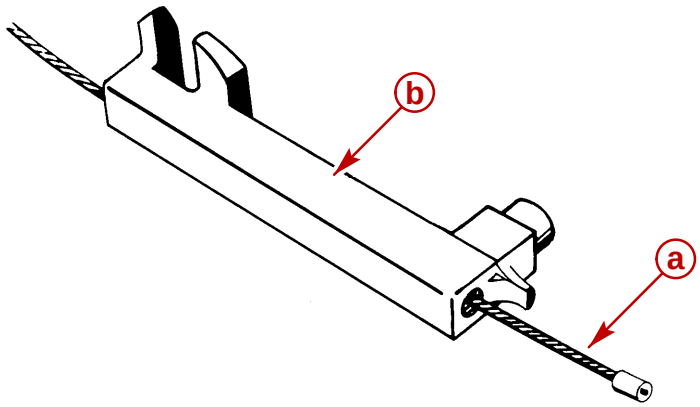
4. Install shift cable wrapping.



22030

a - Shift Cable
b - Shift Cable Wrapping
c - Inner Transom Plate

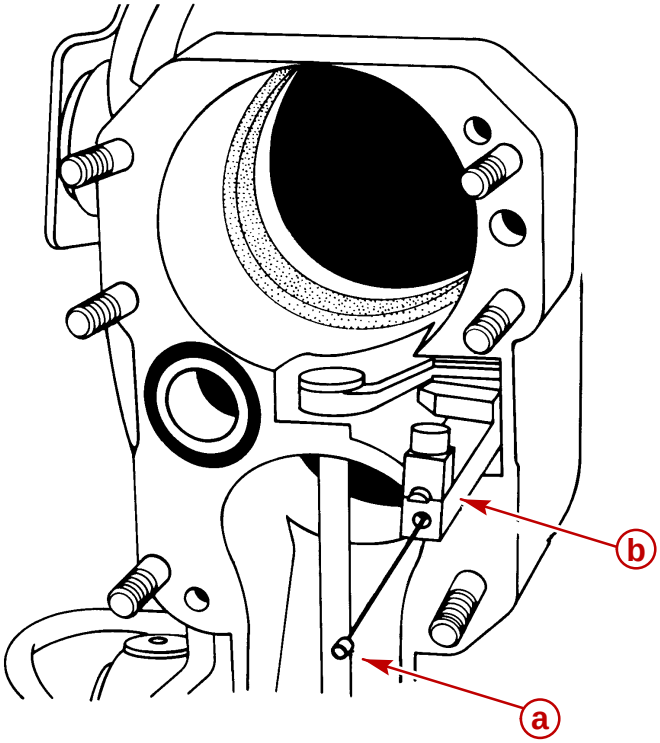
5. Install inner core wire through shift slide.



23262

a - Core Wire
b - Shift Slide

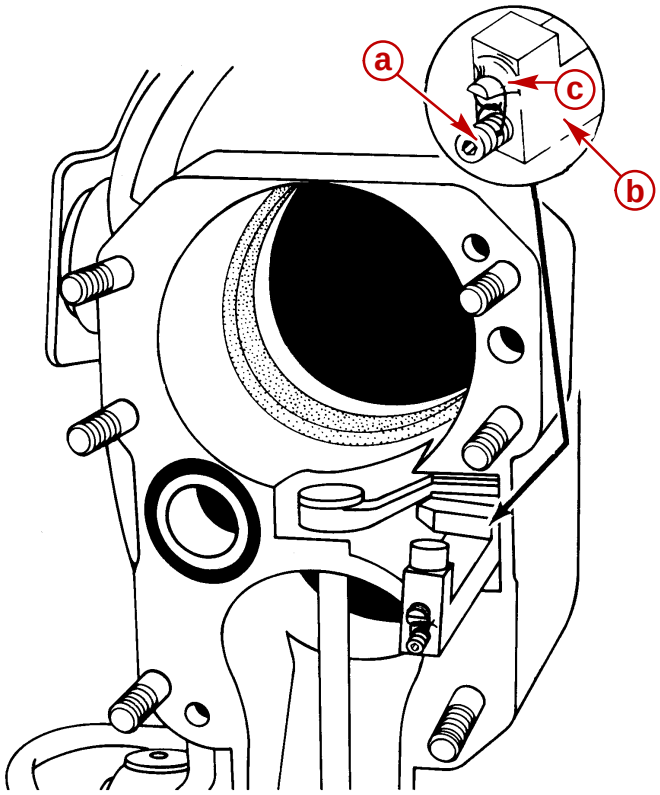
6. Install inner core wire through shift cable.



70138

a - Inner Core Wire
b - Shift Slide

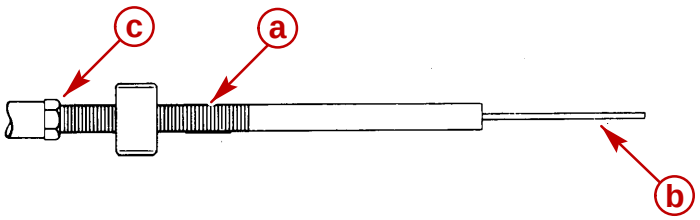
7. Install set screw into shift slide. Tighten until it contacts core wire. Then back off a maximum of 1/8 turn. Safety wire set screw to shift slide using a “figure 8” pattern. Twist until tight and cut off excess length of safety wire.



70138

a - Set Screw
b - Shift Slide
c - Safety Wire

8. Install threaded tube on shift cable and tighten until it bottoms. Secure jam nut against shift cable end.

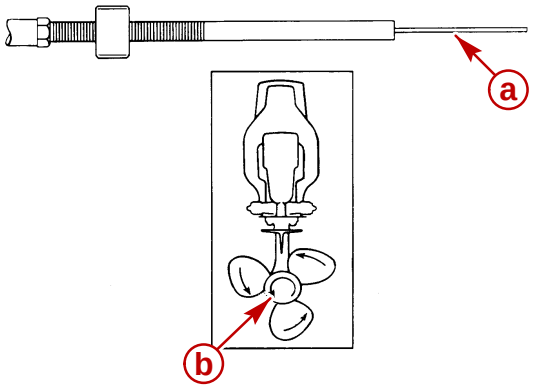


22183

a - Threaded Tube
b - Core Wire
c - Jam Nut

9. Install sterndrive unit.

10. Push in on drive unit shift cable while simultaneously turning propeller shaft counterclockwise until shaft stops. To ensure that clutch is fully engaged, maintain pressure on propeller shaft with a suitable device (elastic strap).



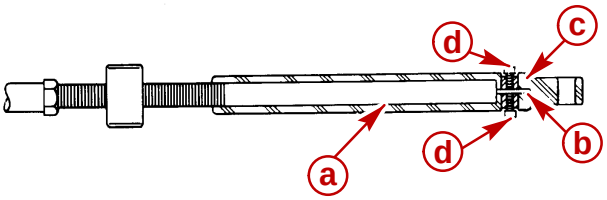
22183

23170

a - Inner Core Wire
b - Propeller Shaft

NOTE: *Clutch engagement will be in forward on right hand rotation units and reverse for left hand rotation.*

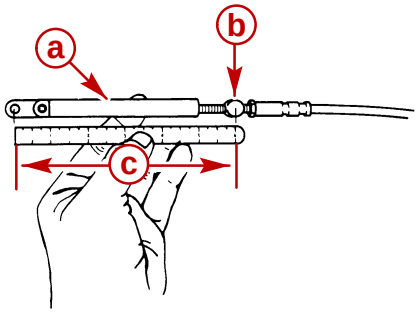
11. Install shift cable end guide over core wire and insert core wire through cable anchor. Tighten screws securely.



22183

a - Shift Cable End Guide
b - Core Wire
c - Cable Anchor
d - Screws (2)

12. While applying light inward pressure, rotate barrel on shift cable threads until distance between center of hole in shift cable end guide and center of brass barrel measure 6 in. (153 mm).



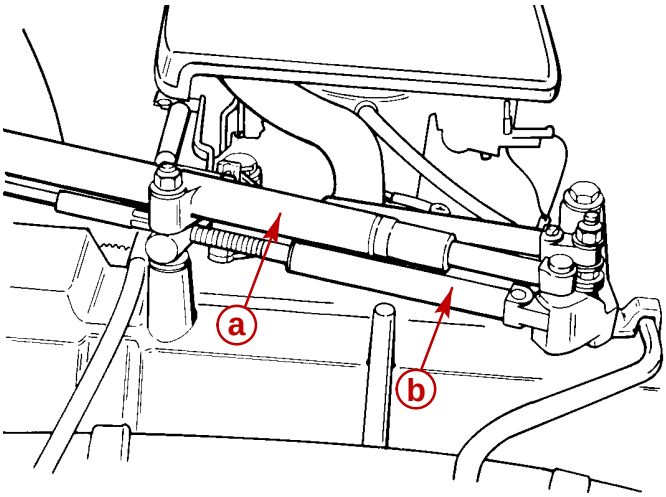
50484

a - End Guide
b - Brass Barrel
c - 6 in. (153 mm)

13. Adjust shift cable.

Remote Control Shift Cable Adjustment (Drive Unit Installed)

NOTE: *The illustrations on the following pages show models that have a shift plate that is mounted on the exhaust elbow. The shift mechanism components on the 3.0L model are located on the top of the valve cover as shown in the following illustration. The procedure for making the adjustments is exactly the same.*



50626

3.0L Model With Components Mounted On Valve Cover

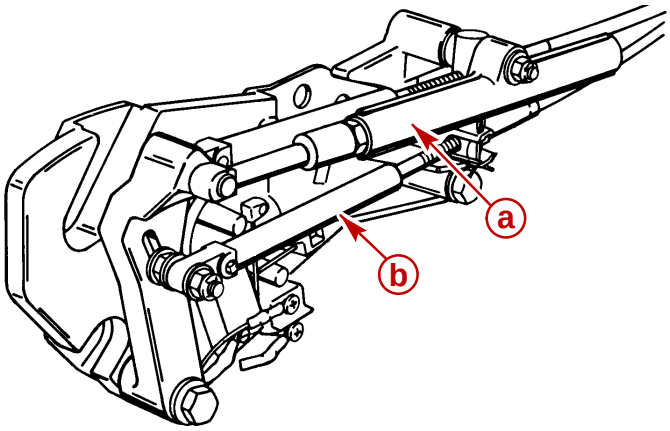
a - Shift Assist Assembly
b - Remote Control Shift Cable

IMPORTANT: Shift cable adjustment for a right hand (RH) rotation drive unit is different than the procedure for adjusting a left hand (LH) rotation drive unit. Be sure to refer to the appropriate procedure when performing the following steps.

IMPORTANT: Drive unit must be installed.

IMPORTANT: DO NOT run engine.

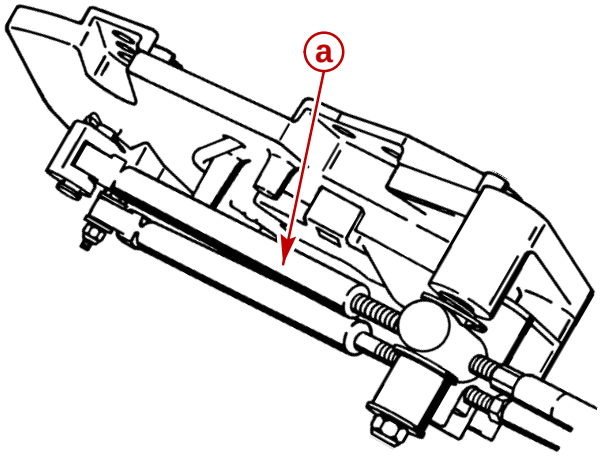
1. Remove remote control shift cable and shift assist assembly (if installed).



50308

With Shift Assist Assembly

a - Shift Assist Assembly
b - Remote Control Shift Cable

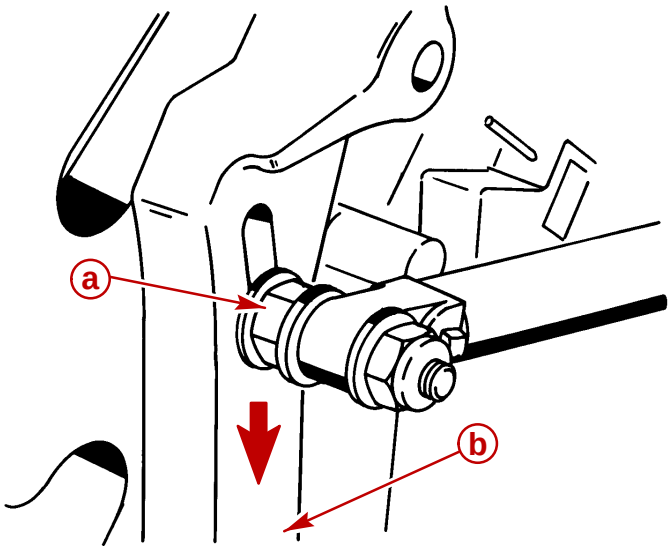


50310

Without Shift Assist Assembly

a - Remote Control Shift Cable

2. Ensure shift lever adjustable stud is at bottom of slot. If necessary, loosen stud and move it to bottom of slot toward the pivot bolt, then retighten stud.

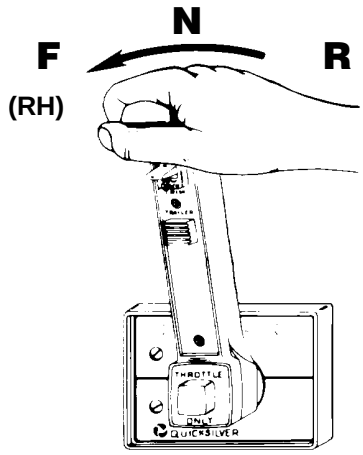


50309

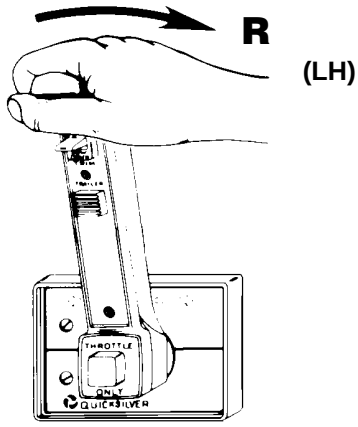
a - Adjustable Stud
b - Toward pivot bolt

3. Shift remote control as stated in “a” or “b” following:

   a. **Right Hand (RH) Rotation Drive Unit -** forward gear, past detent, into wide-open-throttle position.

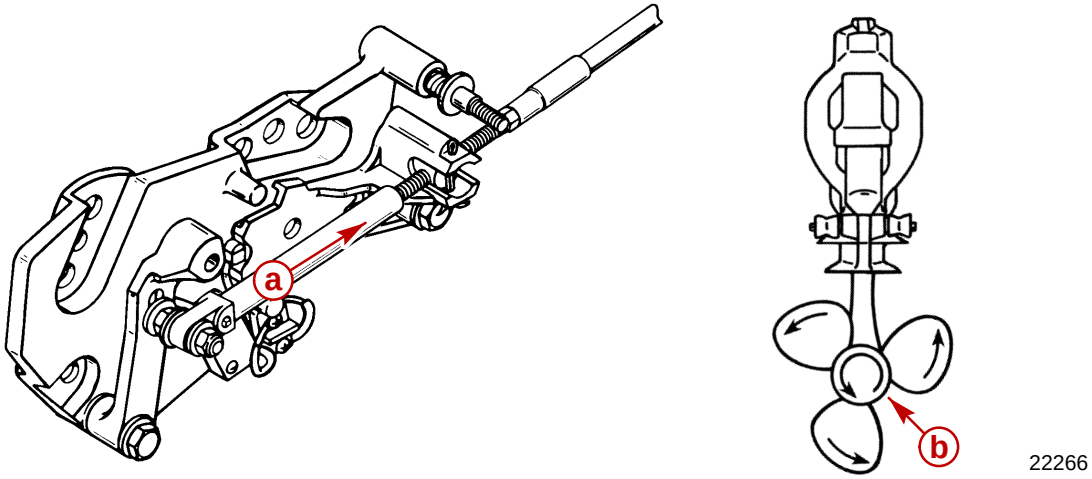


b. **Left Hand (LH) Rotation Drive Unit -** reverse gear, past detent, into wide-open-throttle position.



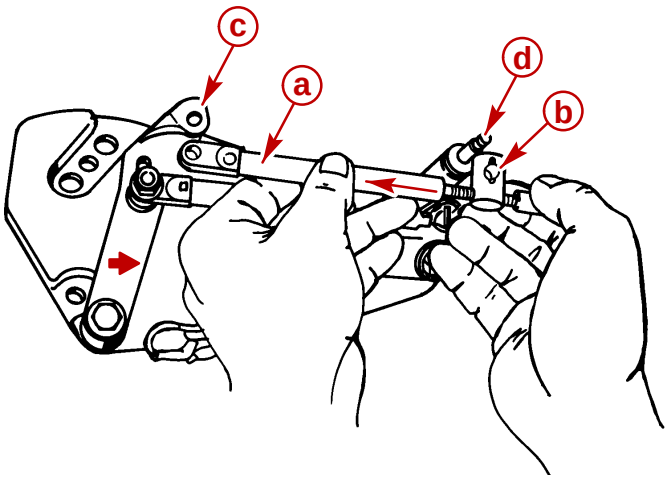
4. Place drive unit into gear by pushing in on drive unit shift cable, while simultaneously rotating propeller shaft counterclockwise until shaft stops, to ensure full clutch engagement. Maintain a light pressure on the drive unit shift cable to hold it at the end of its travel (this removes all slack from the cable).

IMPORTANT: Do not use excessive force when holding pressure on the drive unit shift cable. Excessive force would be indicated by movement of the v-notch on the shift cutout switch.



a - Drive Unit Shift Cable - Push In
b - Propeller Shaft - Rotate Counterclockwise

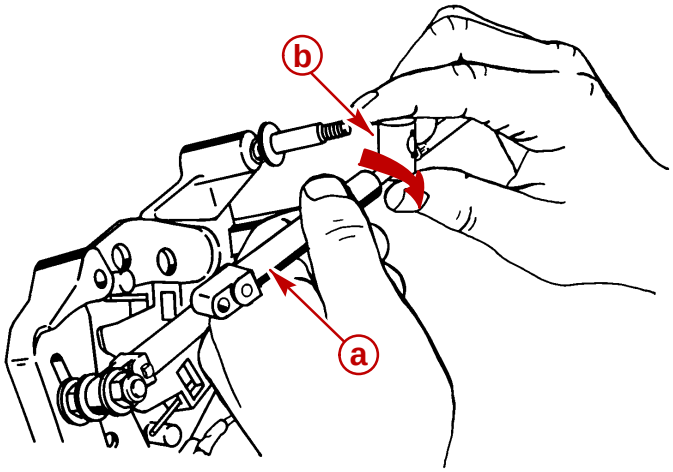
5. Lightly pull on remote control shift cable end guide (to remove slack from remote control and cable) and adjust brass barrel as necessary to align attaching points with shift lever clevis pin hole and stud. Be sure to maintain light pressure on drive unit shift cable.



50309

a - End Guide
b - Brass Barrel
c - Shift Lever Clevis Pin Hole
d - Stud

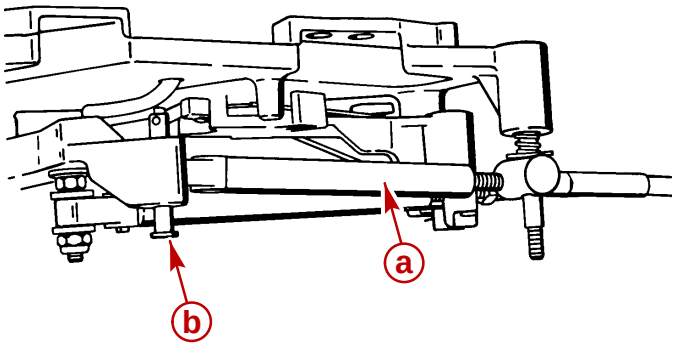
6. After cable has been aligned, turn brass barrel 4 turns **away** from cable end guide.



50308

e - End Guide
f - Brass Barrel

7. Temporarily install remote control shift cable on stud and install clevis pin.

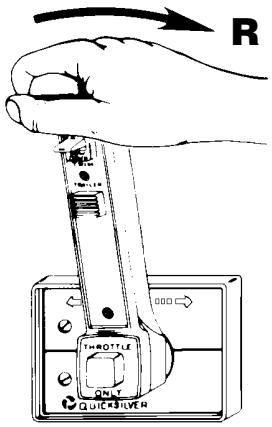


50308

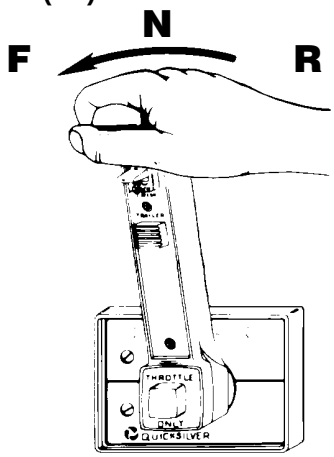
a - Remote Control Shift Cable
b - Clevis Pin

8. Shift remote control as stated in a or b following:
   a. **Right Hand (RH) Rotation Drive Unit -** reverse gear, past detent, into wide-open-throttle position.
   b. **Left Hand (LH) Rotation Drive Unit -** forward gear, past detent, into wide-open-throttle position.

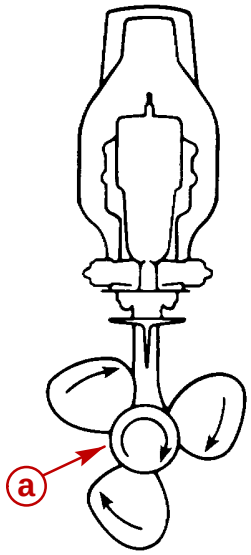
(RH)



(LH)



9. Simultaneously rotate propeller shaft clockwise until shaft stops to ensure full clutch engagement.

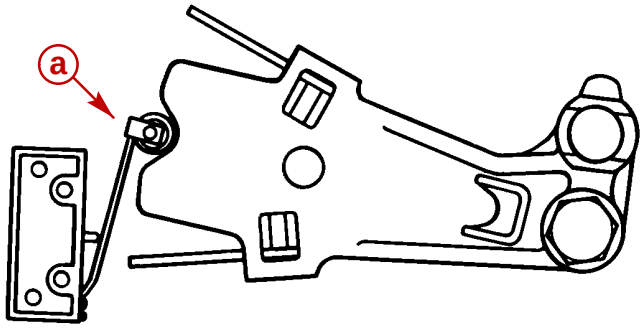


22267

a - Propeller Shaft - Rotate Clockwise

10. Perform a or b as appropriate:

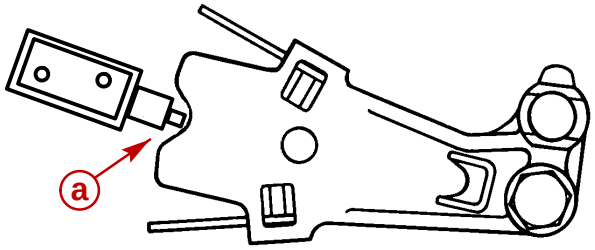
a. **On Models with Earlier Type Switch:** check shift cutout switch lever position. Roller must be centered.



22058

a - Shift Cutout Switch Roller

b. **On Models with Later Type Switch:** check shift cutout switch plunger position. Pin must be centered.



75128

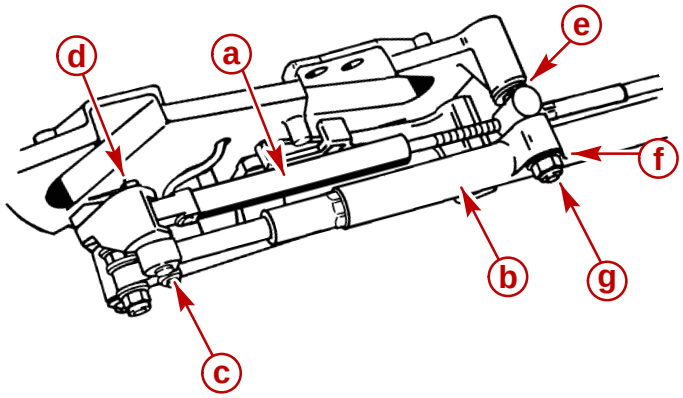
a - Shift Cutout Switch Roller

11. If roller or plunger pin is not centered:
    a. Ensure adjustable stud is at bottom of slot in shift lever.
    b. Check remote control for proper shift cable output [3 in. (76 mm) ± 1/8 in. (3 mm)]. Refer to “Installation Requirements.”
    c. If a and b are correct, ensure drive unit shift cable is not crushed or kinked. (If drive unit shift cable is binding, the shift cutout switch roller or plunger pin will move off center when shifting “into” and “out of” forward **and** reverse).

NOTE: *If shift cable was damaged during installation, install new shift cable assembly in accordance with instructions contained in sterndrive service manual, then repeat shift cable adjustment procedure.*

NOTE: *Some controllers, such as the Commander 3000, have different adjustment procedures. Refer to the appropriate installation instructions for the model being repaired..*

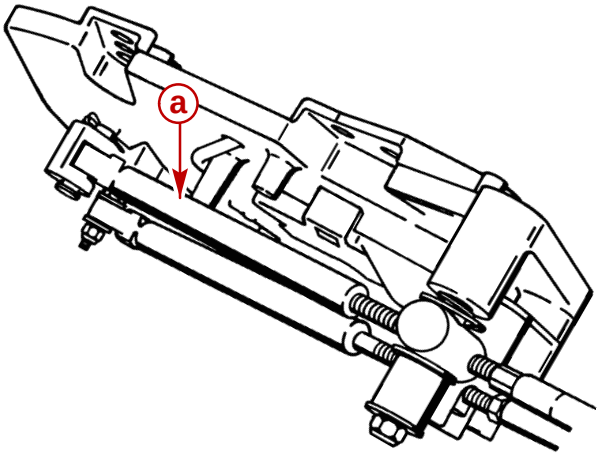
12. After remote control shift cable has been properly adjusted, reinstall cable and shift assist assembly (if applicable) and secure with hardware as shown. If shift assist assembly attaching points will not align, push in or pull out on end of shift assist assembly to install. Do not attempt to readjust shift cable.



50308

With Shift Assist Assembly

a - Remote Control Shift Cable
b - Shift Assist Assembly
c - Clevis Pin
d - Cotter Pin (Spread Both Prongs)
e - Large I.D. Washer
f - Small I.D. Washer
g - Locknut (Tighten Until Bottomed, Then Back Off 1/2 Turn)



50310

Without Shift Assist Assembly

- **a -** Remote Control Shift Cable
- **b -** Clevis Pin
- **c -** Cotter Pin (Existing)
- **d -** Spring (Existing)
- **e -** Washer (Existing)
- **f -** Washer
- **g -** Spacer
- **h -** Washer (Existing)
- **i -** Locknut (Existing) - (Tighten Until Bottomed, Then Back Off 1/2 Turn)

IMPORTANT: If an extra long remote control shift cable is used, or if there are a large number of bends in remote control shift cable, or remote control has inadequate output travel, an additional adjustment may be necessary. Refer to step 12 or 13 as applicable.

13. **Remote Control with Single Lever Shift/Throttle Control:**

    a. **RIGHT HAND (RH) propeller rotation drive unit -** Shift remote control into reverse gear, wide-open-throttle position while simultaneously rotating propeller shaft clockwise. Clutch should engage and cause propeller shaft to lock. If clutch does not engage, loosen adjustable stud on shift lever and move it upward in slot until clutch engages with reverse gear. Retighten stud. Shift remote control several times and stop in reverse to recheck shift cutout switch position. Roller must be centered.

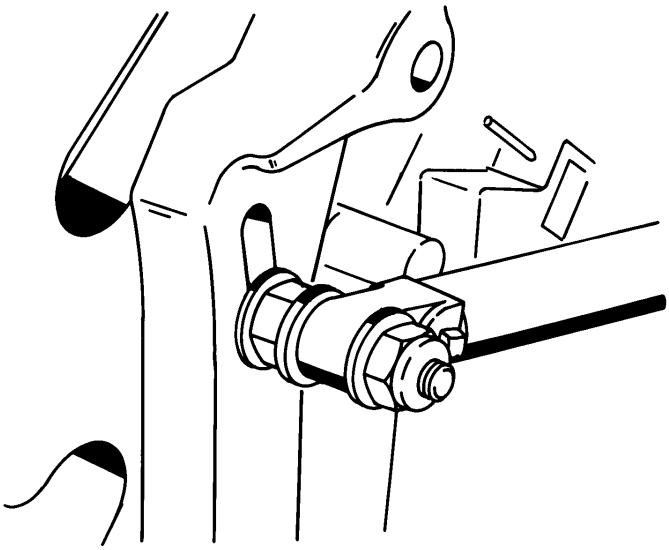
    b. **LEFT HAND (LH) propeller rotation drive unit -** Shift remote control into forward gear, wide-open-throttle position while simultaneously rotating propeller shaft clockwise. Clutch should engage and cause propeller shaft to lock. If clutch does not engage, loosen adjustable stud on shift lever and move it upward in slot until clutch engages with forward gear. Retighten stud. Shift remote control several times and stop in forward to recheck shift cutout switch position. Roller must be centered.

14. **Two Lever Remote Control with Separate Shift and Throttle Levers:**

    a. **RIGHT HAND (RH) propeller rotation drive unit -** While turning propeller shaft clockwise, move remote control shift handle into full reverse position. Clutch should engage before shift lever comes to a stop. If clutch does not engage, loosen

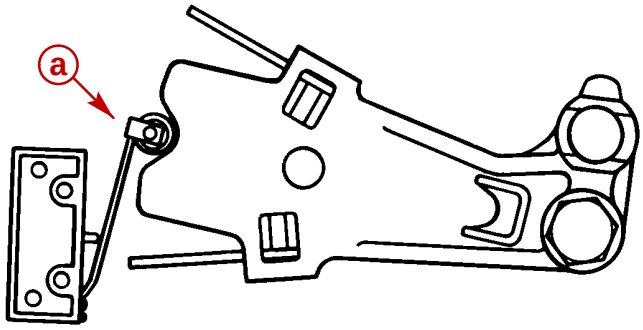
adjustable stud on shift lever and move it upward in slot until clutch engages with reverse gear. Retighten stud. Shift remote control several times and stop in reverse to recheck shift cutout switch position. Roller must be centered.

b. **LEFT HAND (LH) propeller rotation drive unit -** While turning propeller shaft clockwise, move remote control shift handle into full forward position. Clutch should engage before shift lever comes to a stop. If clutch does not engage, loosen adjustable stud on shift lever and move it upward in slot until clutch engages with forward gear. Retighten stud. Shift remote control several times and stop in forward to recheck shift cutout switch position. Roller or pin must be centered.



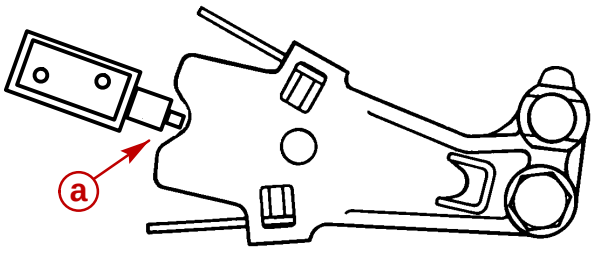
50309

a - Adjustable Stud



22058

a - Shift Cutout Switch Roller



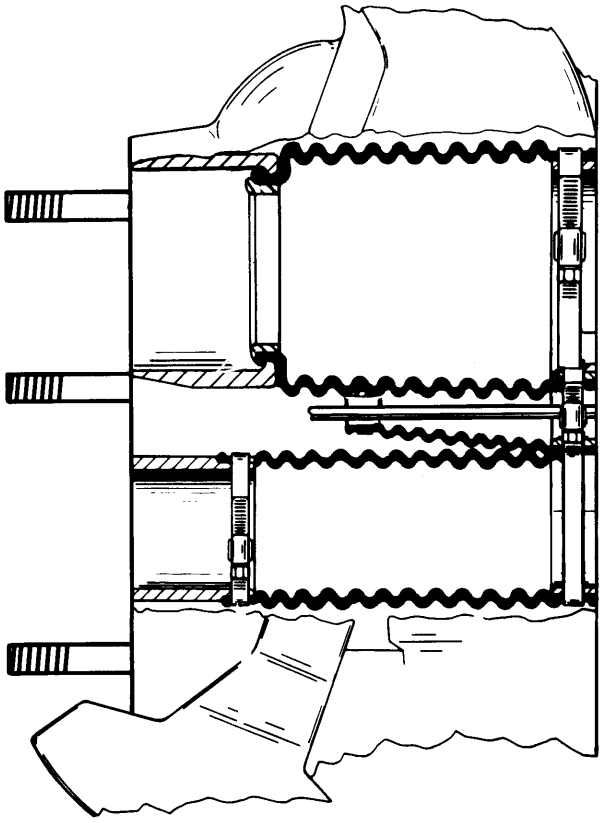
75128

a - Shift Cutout Switch Roller

Exhaust Bellows

Removal

1. Remove sterndrive unit.
2. Loosen hose clamps and remove exhaust bellows.



75269

a - Exhaust Bellows
b - Hose Clamps

Cleaning And Inspection

1. Inspect exhaust bellows for internal charring, cracks, cuts or hardening.
2. Clean old adhesive from bellows mounting flange on gimbal housing and on bell housing with lacquer thinner.
3. If reusing old bellows, clean old adhesive from mounting surfaces of exhaust bellows.
4. Roughen exhaust bellows mating surfaces with sandpaper and wipe clean with lacquer thinner.

Installation

⚠ WARNING

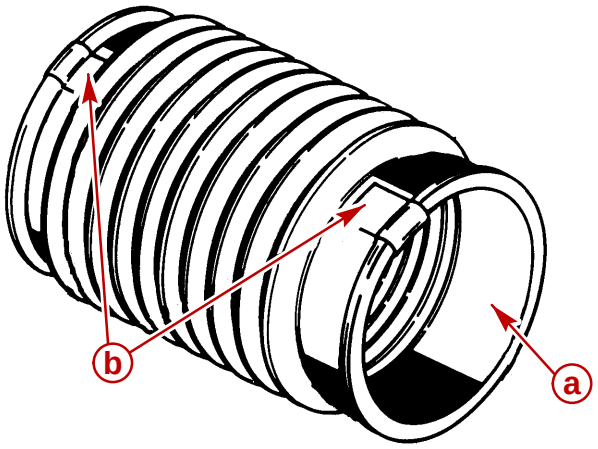
Bellows adhesive contains toluol and petroleum distillates which are harmful or fatal if swallowed. Avoid prolonged contact with skin or breathing of vapors. If swallowed, do not induce vomiting. Call physician immediately. Keep out of reach of children.

1. Apply bellows adhesive to mounting surfaces on inside of bellows. Allow to dry until no longer tacky (approximately 10 minutes).

⚠ CAUTION

Bellows clamp may corrode if grounding clips are not installed.

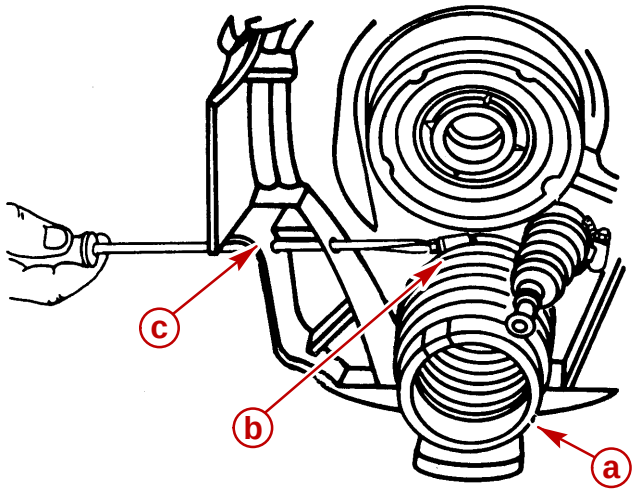
2. Position grounding clips on bellows.



22079

a - Mounting Surface (Apply Bellows Adhesive)
b - Grounding Clips

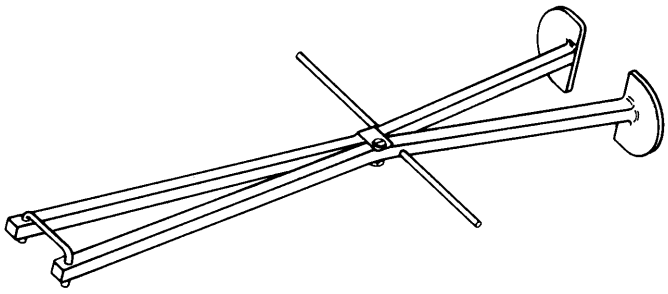
3. Install exhaust bellows on gimbal housing. Position hose clamp as shown. Tighten hose clamp screw to 35 lb-in. (8-10 Nm) using a screwdriver through access holes in gimbal housing.



70199

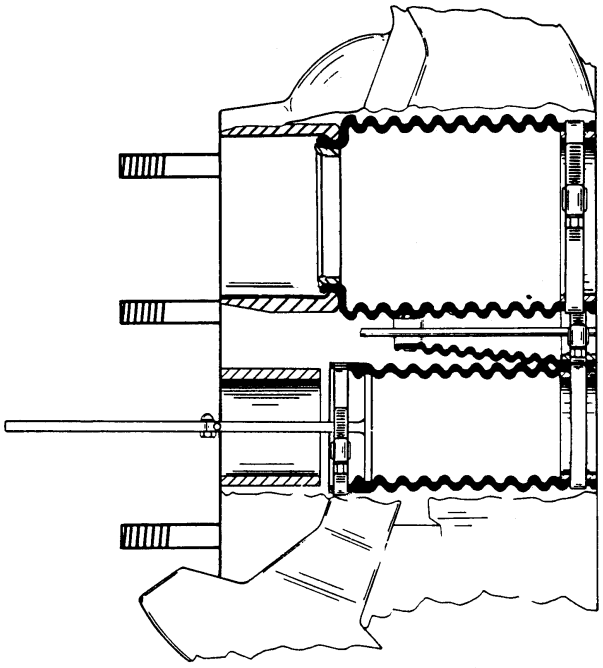
a - Exhaust Bellows
b - Hose Clamp
c - Gimbal Housing Access Hole

4. Install exhaust bellows on bell housing as follows:
   a. Place hose clamp over bellows end.
   b. Place expander tool (91-45497A1) through bell housing into first bellows convolution.



22161

c. Pull tool until tool touches the flange on bell housing (bellows starts to slip onto flange); then release tool.



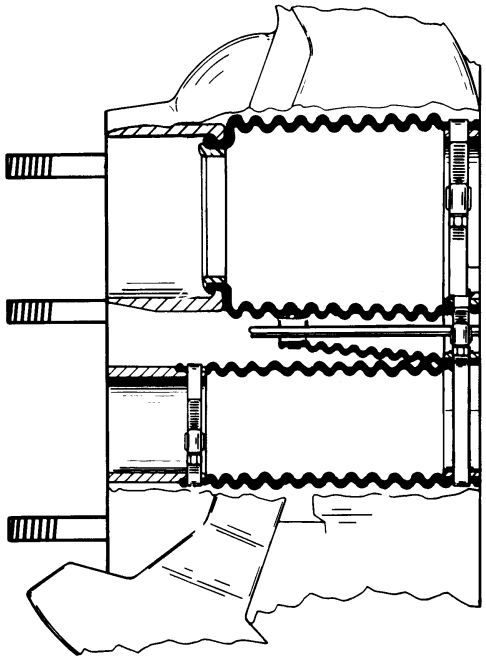
75270

a - Expander Tool (91-45497A1)
b - Bell Housing Flange

d. Reposition tool into the third bellows convolution.

e. Pull bellows onto bell housing flange.

f. Torque hose clamp to 35 lb-in. (4 Nm).



75269

a - Exhaust Bellows
b - Hose Clamp

Gear Lube Monitor Kit System Components - Replacement

Monitor To Thru-Bulkhead Fitting Hose:

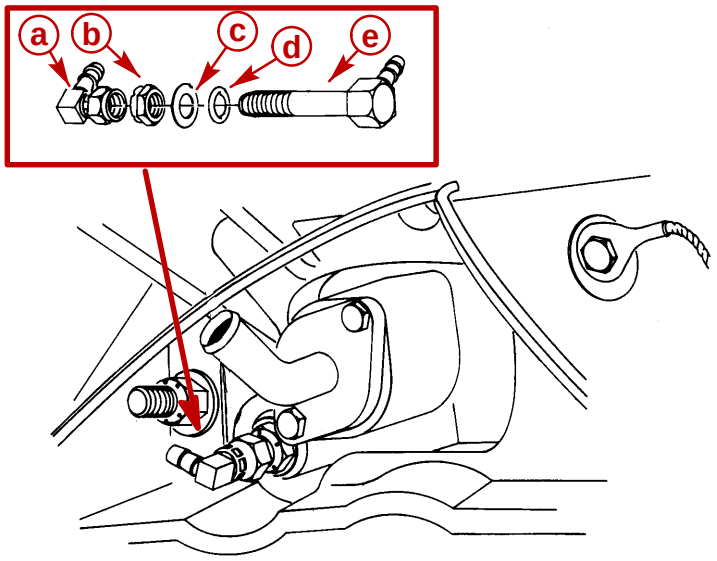
EARLIER STYLE

Check hose periodically for condition, including cracks, hardening, etc.; replace as necessary.

1. To replace hose, remove hose clamps and clip, then remove hose.
2. Install new hose of sufficient length to allow reservoir to be removed from topside or bottom-side of bracket. Secure hose with hose clamps.
3. If thru-bulkhead fitting was taken out to remove gimbal housing. The following steps must be completed.
4. Install gimbal housing fitting through housing. Ensure the hex on fitting lines up with formed cavity in housing, which prevents fitting from rotating.
5. Install washer and secure assembly with locknut. Torque to 12 lb-ft (16.5 Nm).

IMPORTANT: To ensure that fitting is seated securely in cavity there should be 1/2 in. (12.7 mm) of threads protruding through the top of the nut to the end of the gimbal housing fitting.

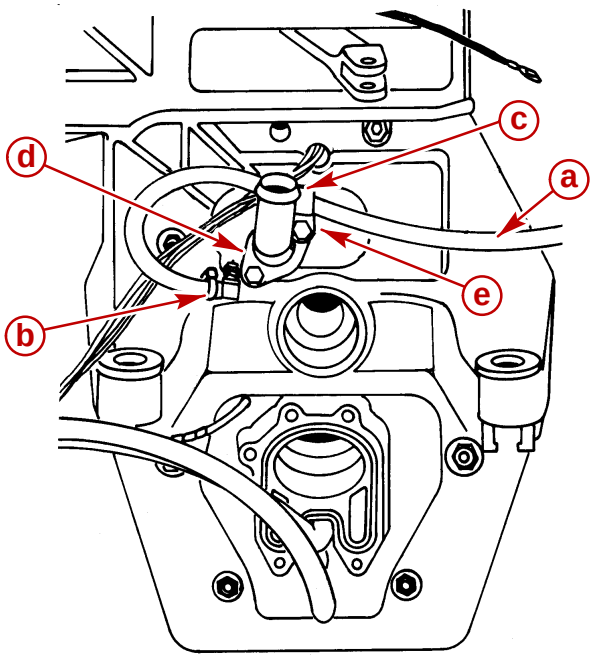
6. Install 90 degree swivel fitting and position as shown while torquing to 80 lb-in. (9 Nm).



70006

a - Swivel Fitting
b - Locknut
c - Washer
d - O-ring
e - Gimbal Housing Fitting

7. Connect oil reservoir hose to 90 degree fitting and secure with hose clamp. If required, remove screw from water cover plate and retain hose with clip. Retorque water cover plate screw to 95 lb-in. (10.8 Nm).



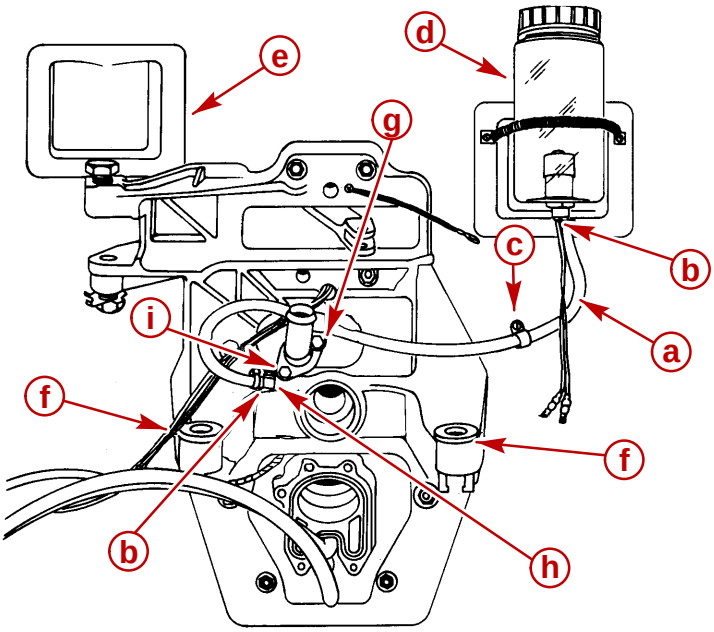
70023

a - Hose
b - Hose Clamp
c - Hose Clip
d - Water Cover Plate
e - Screw

IMPORTANT: Location of reservoir bracket is optional. If bracket is moved, installation must not cause hose (when routed) to interfere with the movement of the power steering assembly or engine coupler. MINIMUM HEIGHT OF INSTALLATION: bottom of bracket must be no lower than the top surface of the fiber washers upon which the engine mounts set.

NOTE: *If location does not require that the connecting hose crosses the inner transom plate to port side, the J-clip on water pickup outlet (top bolt) would neither be needed nor installed. The plastic hose clip can be used to hold hose in position, if needed, on transom and prevent it from contacting the power steering assembly or engine coupler, after they are installed.*

8. If bracket is being mounted port side, attach seawater outlet and gasket, with J-clip at top bolt, at location shown. Do not mount where any component will interfere with power steering assembly, when installed. If mounting bracket on starboard side, do not use or attach J-clip.



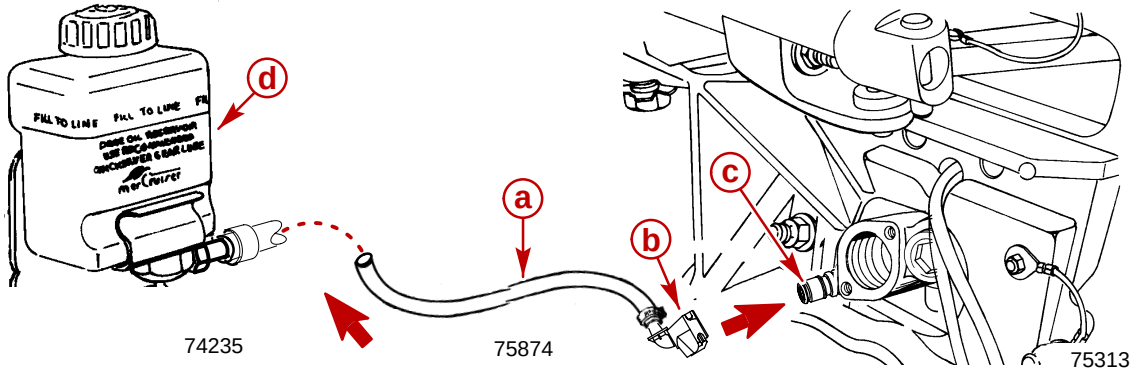
70023

a - Connecting Hose
b - Hose Clamp (2)
c - Plastic Hose Clip
d - Oil Monitor Bottle
e - Bracket (Alternate Location)
f - Fiber Washers
g - Clip
h - 90° Hose Barb Compression Fitting
i - Locknut And Washer

LATER STYLE

1. Connect the gear lube monitor hose to a quick release 90° fitting.
2. Connect fitting to the gimbal housing.

IMPORTANT: Hose must not come in contact with steering system components or the engine coupler, U-joint shaft or drive shaft.

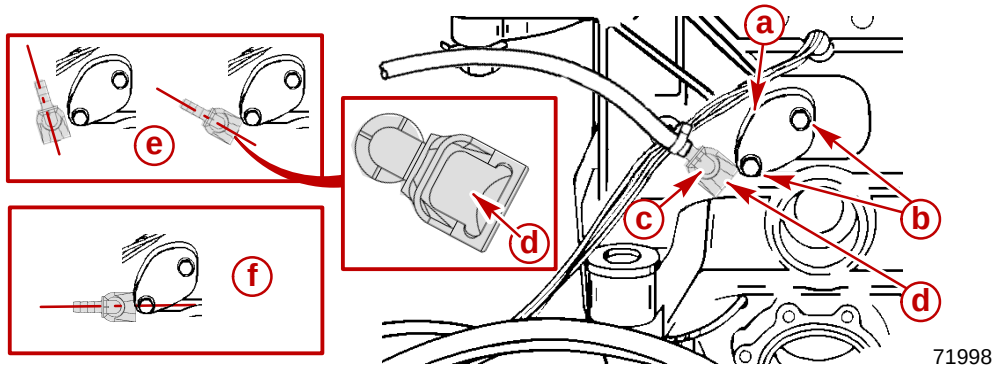


a - Hose
b - 90° Hose Fitting
c - Gimbal Housing Fitting
d - Gear Lube Monitor

NOTE: *The quick release button on hose fitting must be positioned away from water inlet fitting, or block-off plate, if equipped. Release button must not contact water fitting, or block-off plate if equipped.*

⚠ CAUTION

Avoid sterndrive unit damage. Quick release button on gear lube monitor 90° hose fitting may not lock on gimbal housing if touching or depressed by water inlet fitting, or block-off plate, if equipped. Ensure quick release button does not contact block-off plate, or water inlet fitting if equipped. Failure to do so could result in a loose 90° fitting causing a loss of gear lube and damage to drive unit.

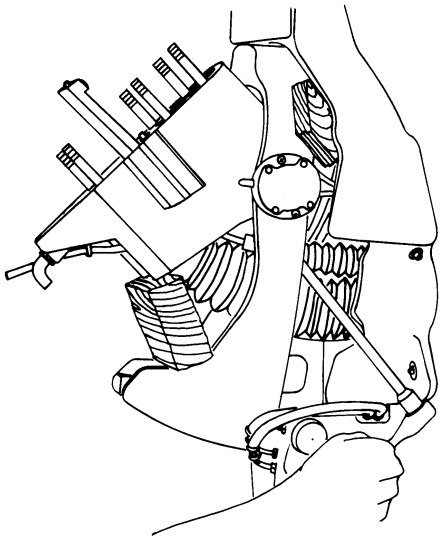


Block-Off Plate Installation Shown (Similar For Models With Water Fitting)
a - Block-Off Plate (Or Water Inlet Fitting If Equipped)
b - Star Washer and Screw
c - 90° Hose Fitting
d - Quick Release Button
e - ACCEPTABLE Positions
f - NOT ACCEPTABLE Position

NOTE: *The hose must not come into contact with the steering system components or the engine coupler and drive shaft.*

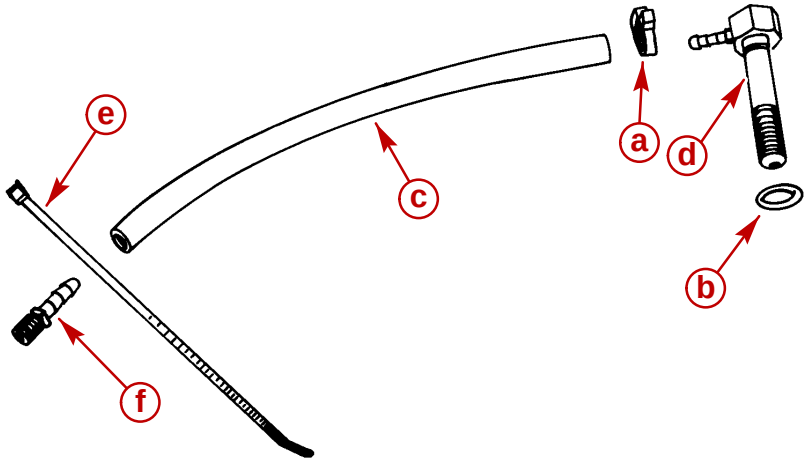
Thru-bulkhead To Bell Housing Gear Lube Monitor Hose

1. If the bell housing gear lube monitor hose was removed. Apply Perfect Seal to threads of hose connector and install into bell housing. Torque to 8 lb-ft (11 Nm).



70041

2. Pre-assemble 10 in. (254 mm) long hose to the barbed end of the through-gimbal housing fitting and tighten clamp securely so that clamp tensioner will be accessible when fitting is installed.

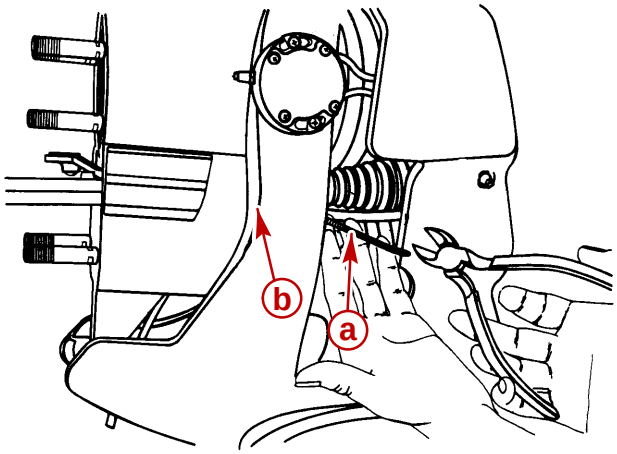


70038

a - Clamp
b - O-ring
c - 10 inch (254 mm) Hose
d - Gimbal Housing Fitting
e - Cable Tie
f - Connector (Assembled In Bell Housing)

3. Pre-assemble cable tie so it can be slid up the hose and positioned over straight fitting.
4. Push 10 inch (254 mm) hose over straight connector already assembled in bell housing. Be sure hose is as far up on connector as possible.

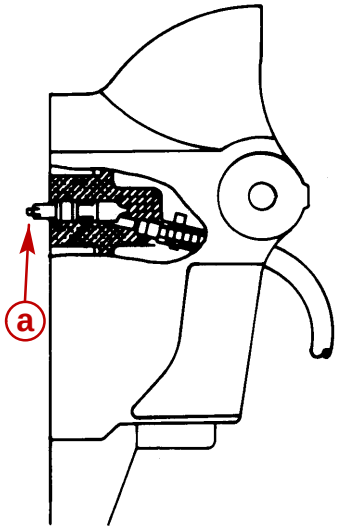
5. Slide cable tie down the hose until it is over the connector. Pull the cable tie tight with needle nose pliers. Then carefully cut tie taking care not to puncture any internal parts.



70043

a - Cable Tie
b - Hose

6. Apply oil to O-rings on anti-dribble valve and install into bell housing making sure that the shoulder on valve is completely flush to the bell housing face.



70029

a - Anti-Dribble Valve

7. When installing new gasket the hole with silicon seal should be positioned around anti-dribble valve. Install sterndrive unit.

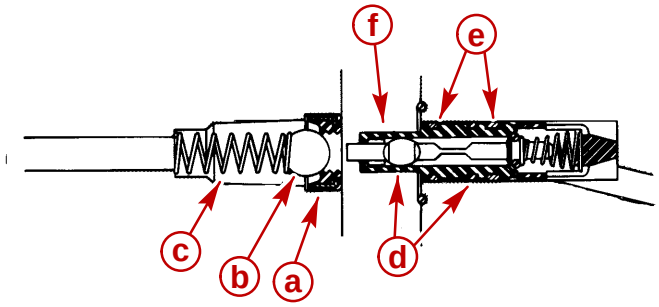
Bell Housing To Driveshaft Housing Anti-Dribble Valves

Unless damaged during disassembly, or by heat, these anti-dribble valves should last the life of the drive unit.

The bell housing anti-dribble valve is replaced as an assembly.

REMOVAL

1. The bell housing anti-dribble valve can be removed with pliers and discarded, or it can be removed by placing hose clamp snugly over area “f,” and pulling out, with pliers on hose clamp and reinstalled if working properly.
2. The driveshaft housing anti-dribble valve can be removed by retracting the seal cup with a pliers or hook and discarded. Remove the check valve and spring and discard.



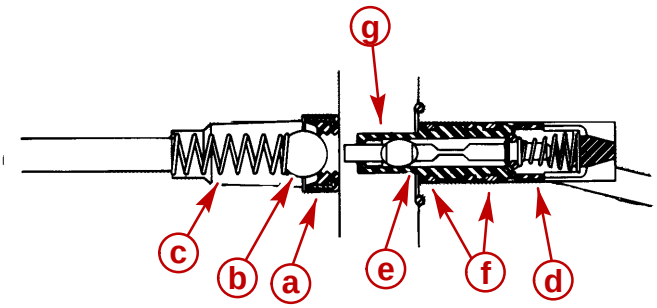
50321

Drive Shaft Housing **Bell Housing**

a - Seal Cup
b - Check Ball
c - Spring
d - Check Valve Assembly
e - O-rings (2)
f - Area To Secure Hose Clamp For Retraction

REASSEMBLY

1. **Driveshaft Housing -** insert spring, check ball and seal cup - press or tap, carefully, on seal cup until outer face is flush with casting surface, as shown. Do not use sealant.
2. **Bell Housing -** coat O-rings with Gear Lube; insert check valve assembly into passageway, place 3/8 in. deep wall socket over valve end and tap into casting until shoulder surface “e” is flush with casting surface.

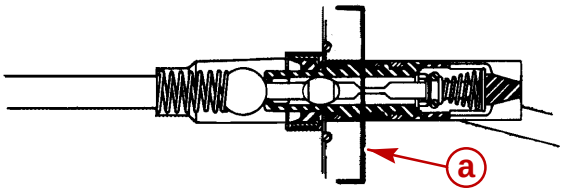


50321

Drive Shaft Housing **Bell Housing**

- **a -** Seal Cup
- **b -** Check Ball
- **c -** Spring
- **d -** Bell Housing Check Valve Assembly
- **e -** This Surface Must Be Flush With Casting
- **f -** O-rings (2)
- **g -** Valve End

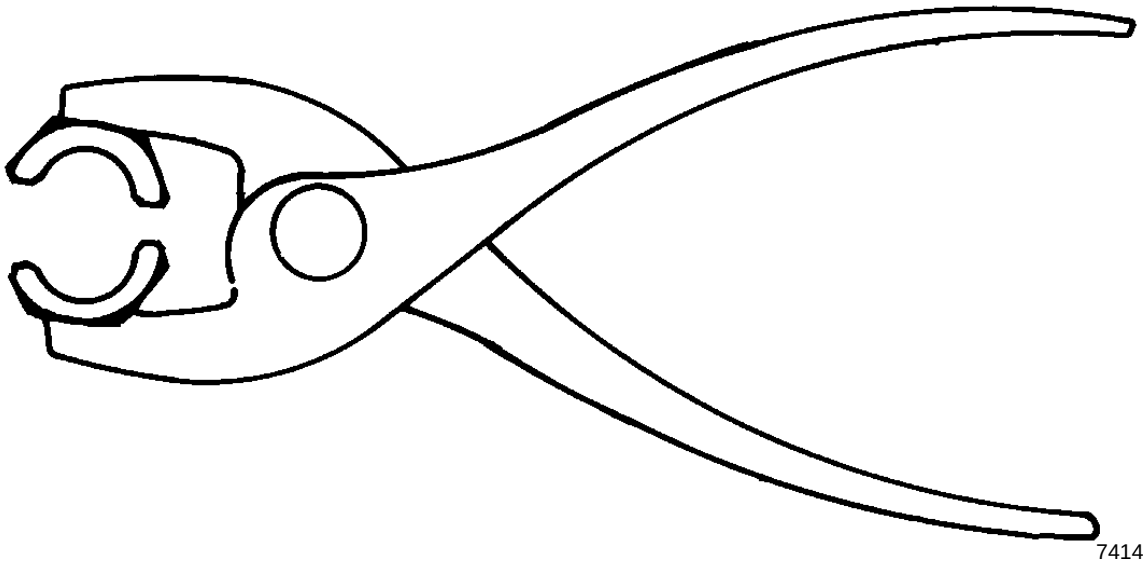
3. After units are connected and drive unit and gear lube monitor are filled with Gear Lube, check area “a,” and under bottom seam of mating surfaces, for oil leak. Recheck for oil leak after first use.



50321

- **a -** Connection Area

Crimp Clamp Tool



a - Bevel Edges
b - 3/4 in. Nut
c - Pliers
d - Saw Nut in Half

1. Weld a 3/4 in. nut to the jaws of a pair of pliers (as shown).
2. Saw the nut in half without damaging the pliers.
3. Clamp the jaws of the pliers in a vice so that the two halves of the nut are pressed firmly together.
4. Use a 1/2 in. drill bit to drill the threads out of the nut.

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TRANSOM ASSEMBLY

Section 4B - Service Procedures Requiring Major Disassembly

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Transom Assembly Specifications

Torque Specifications

Description	Torque		
	lb-in.	lb-ft	Nm
Shift Cable Core Wire Anchor Screws	20		2.3
Bellows Hose Clamps	35		4
Gimbal Ring to Bell Housing Hinge Pins		100	143
Gimbal Ring Screws		55	74
Steering Screw and Nut		60	81
Transom Assembly Attaching Screws, Nut		22.5	30.5
90°Fitting Nut		12	16.5
90°Fitting	80		9
Oil Fill/Drain Screw		23	30

Special Tools

Description	Part Number
Bearing Removal and Installation Tool	91-31229A1
Bellows Expander Tool	91-45497A1
Slide Hammer Puller	91-34569A1
Shift Cable Removal and Installation Tool	91-12037
Driver, Needle Bearing	91-33492T
Driver, Needle Bearing	91-33491
Driver, Bearing	91-33489
Driver Head	91-32325T
Driver Rod	91-37323
Drive Shaft Nut Wrench	91-56775T
Alignment Tool Assembly	91-805475A1
Expander Tool	91-45497A1
Hinge Pin Tool	91-78310
Mandrel	91-30366-1
Nut	11-24156
Plate (2)	91-29310
Puller	91-63616T
Puller Head	91-38919
Puller Shaft	91-31229
Washer	12-34961
Bushing Installation Tool	91-806928T
Sleeve Installation Tool	91-818169T
Sleeve Removal Tool	91-818162

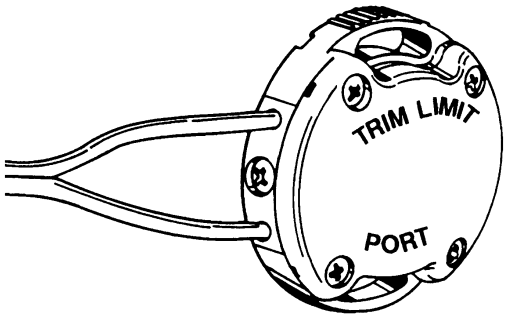
Lubricants / Sealers / Adhesives

Description	Part Number
3M Brand Adhesive	92-86166Q1
Quicksilver 2-4-C Marine Lubricant With Teflon	92-825407A12
Quicksilver U-Joint AndGimbal Bearing Grease	92-828052A2
Perfect Seal	92-34227-1
Anti-Corrosion Grease	92-78376A6
Locquic Primer “T”	92-809824
Loctite 27131	92-809820
Quicksilver Special Lubricant 101	92-13872A1

Special Information

Trim Limit Switch

The trim limit switch has a sealing system for improved water resistance and durability. The trim limit switch leads are connected internally to help ensure good electrical integrity.

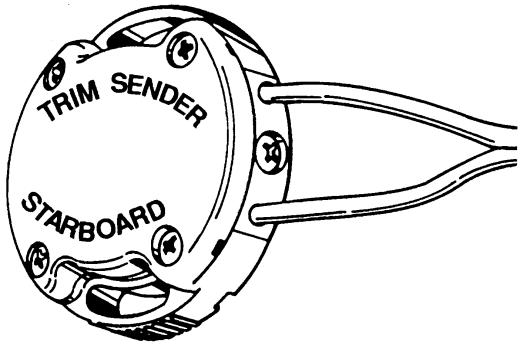


71415

Trim Limit Switch - Port

Trim Position Sender

The trim position sender has a sealing system for improved water resistance and durability. The trim limit leads are connected internally to help ensure good electrical integrity.

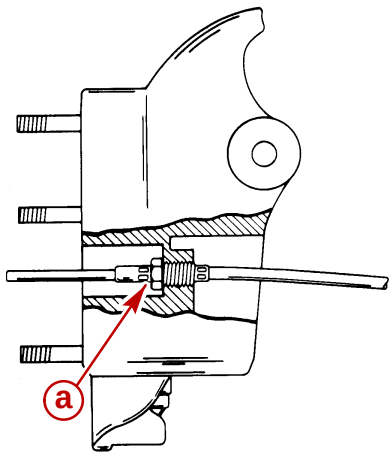


71414

Trim Position Sender - Starboard

Shift Cable

A Drive Unit Shift Cable Removal and Installation Tool 91-12037 is required for cable removal and installation.



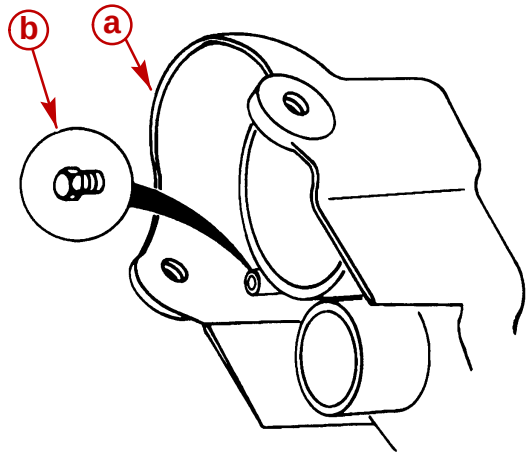
23156

a - Shift Cable Retaining Nut

IMPORTANT: The shift cable should be replaced as an assembly only.

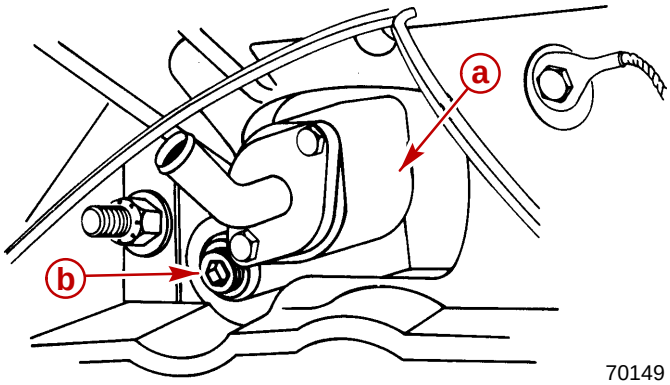
Gear Lube Monitor Kit Access Plug Locations

This model has the option to be equipped with a remote oil monitor. These plugs only need to be removed during installation of that kit.



70876

a - Bell Housing
b - Hex Head Plug

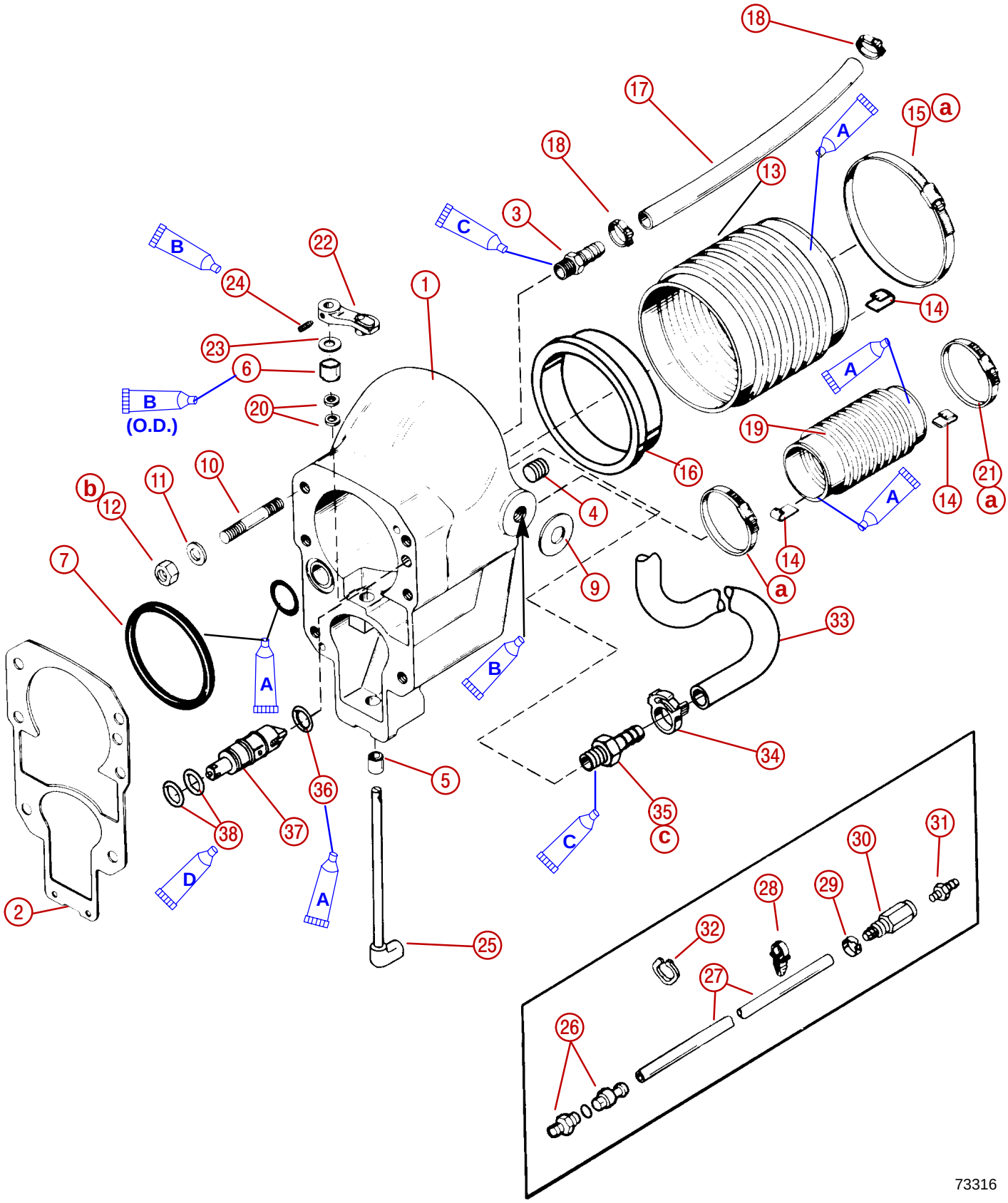


70149

a - Gimbal Housing
b - Allen Head Pipe Plug

Alpha One Transom Assembly Exploded View

Bell Housing Components



1 - Bell Housing Assembly
2 - Gasket
3 - Connector
4 - Pipe Plug
5 - Bushing
6 - Bushing
7 - Gasket (Rubber)
8 - O-Ring
9 - Washer (Synthane)
10 - Stud
11 - Washer
12 - Nut
13 - Universal Joint Bellows
14 - Ground Clip
15 - Clamp
16 - Sleeve
17 - Hose
18 - Clamp
19 - Exhaust Bellows
20 - Seals
21 - Clamp
22 - Lever Assembly
23 - Washer
24 - Screw
25 - Shift Shaft (Upper)
26 - Coupling Assembly
27 - Tubing
28 - Clip
29 - Clamp
30 - Fitting Assembly
31 - Connector
32 - Clamp
33 - Hose
34 - Clamp
35 - Connector
36 - O-Ring
37 - Valve Assembly
38 - O-rIng

Lubricants/Sealers/Adhesives

A - 3M Brand Adhesive

B - Loctite 27131

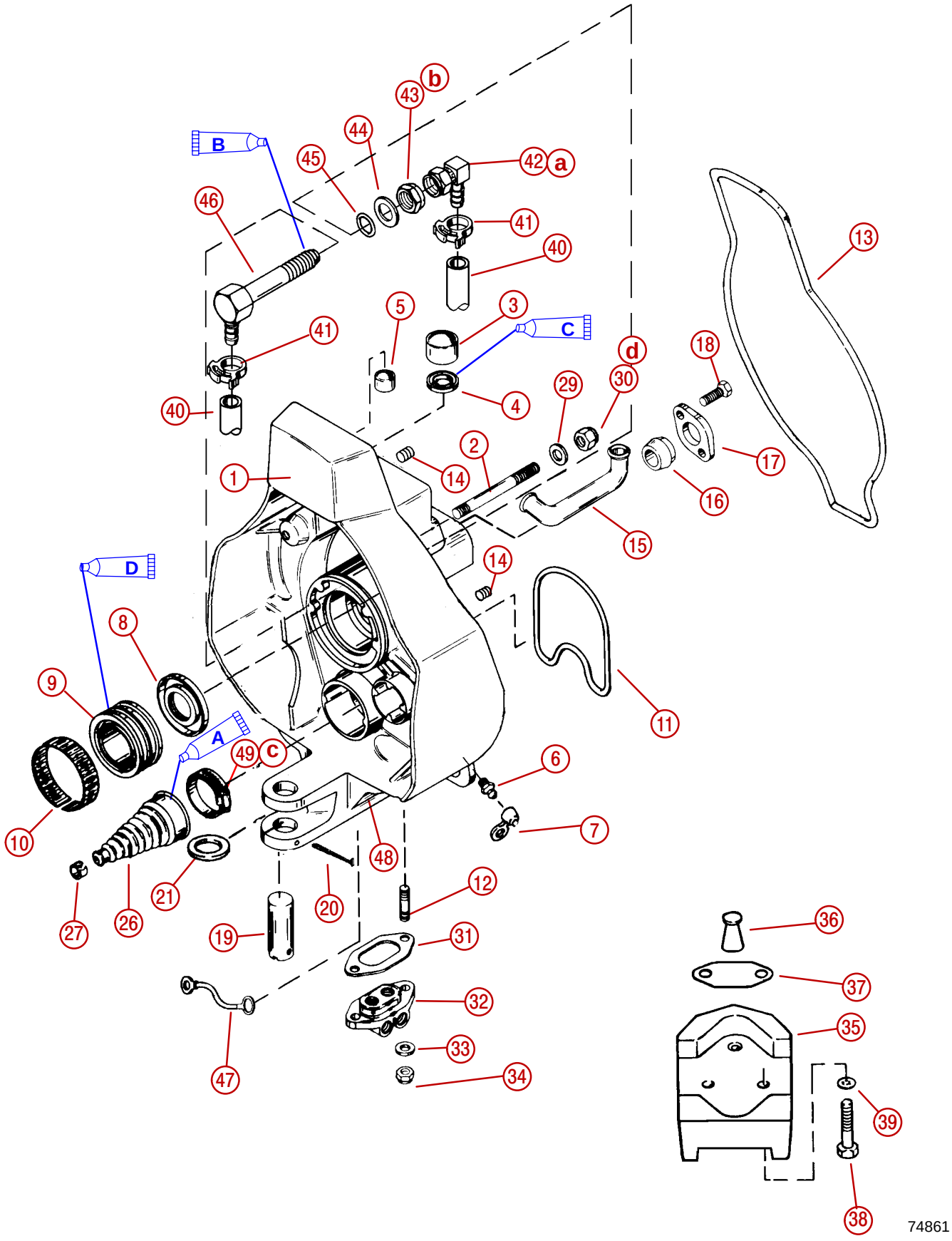
C - Quicksilver Perfect Seal

D - Quicksilver High Performance Gear Lube

Torque Specifications

a - Tighten Securely Approximately 35 lb-in. (4 Nm)
b - 50 lb-ft (68 Nm)
c - 8 lb-ft (11 Nm)

Gimbal Housing Components



1 - Gimbal Housing
2 - Stud
3 - Lower Bushing
4 - Oil Seal
5 - Upper Bushing
6 - Grease Fitting
7 - Lubricap
8 - Grease Seal
9 - Bearing Assembly
10 - Tolerance Ring
11 - O-Ring
12 - Stud
13 - Seal
14 - Pipe Plug
15 - Water Tube
16 - Bushing
17 - Cover
18 - Screw
19 - Lower Swivel Pin
20 - Cotter PIn
21 - Washer
22 - Bolt
23 - Washer
24 - Washer
25 - Nut
26 - Bellows
27 - Clamp
28 - Clamp
29 - Washer
30 - Nut
31 - Gasket
32 - Connector
33 - Lock Washer
34 - Nut
35 - Anodic Plate
36 - Seal
37 - Gasket
38 - Screw
39 - Lock Washer
40 - Hose
41 - Clamp
42 - 90° Fitting
43 - Nut
44 - Washer
45 - O-Ring
46 - Connector
47 - Continuity Wire
48 - Continuity Wire Connection
49 - Hose Clamp

Lubricants/Sealers/Adhesives

- 3M Brand Adhesive

- Quicksilver Perfect Seal

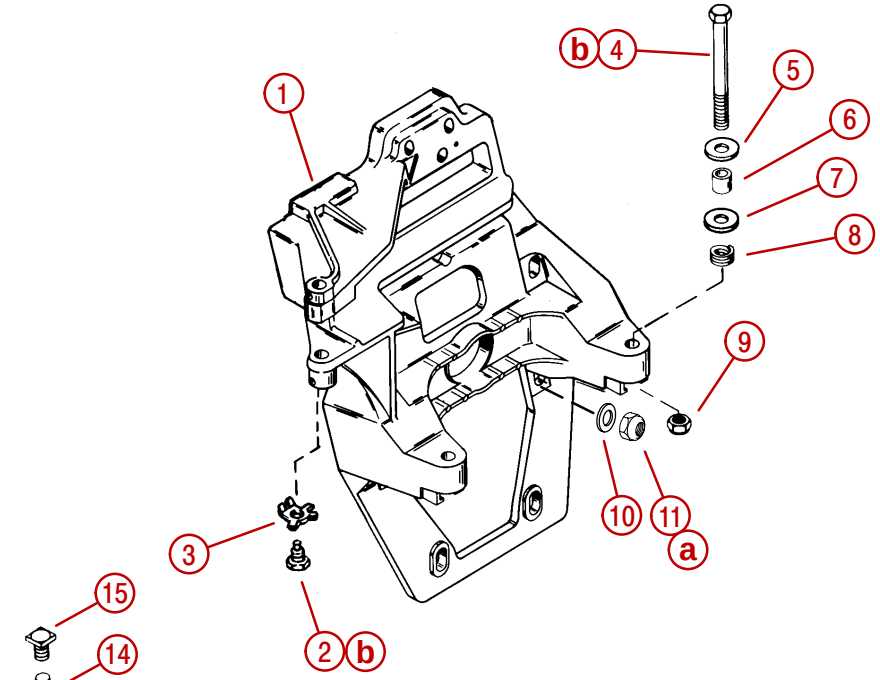
- Loctite 27131

- Quicksilver U-Joint And Gimbal Bearing Grease

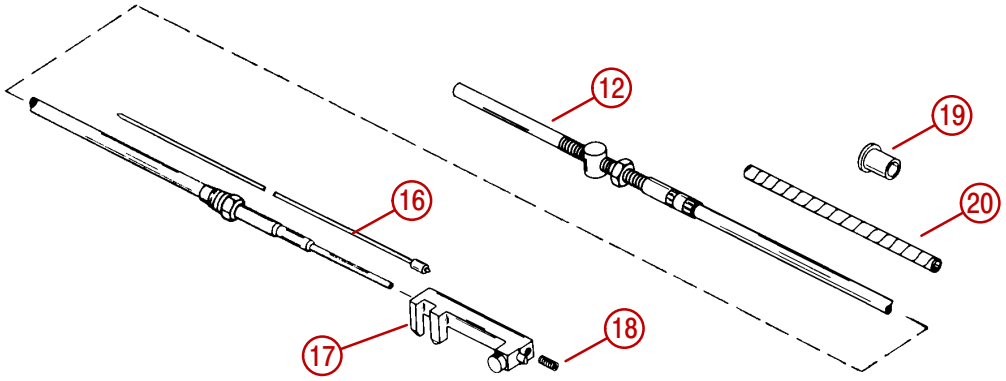
Torque Specifications

a - 80 lb-in. (9 Nm)
b - 12 lb-ft (16.5 Nm)
c - Approximately 35 lb-in. (3.96 Nm)
d - 25 lb-ft (34 Nm)

Inner Transom Plate Components



74850



74865

1 - Transom Plate Assembly
2 - Pivot Bolts
3 - Tab Washers
4 - Screw Engine Mounting
5 - Washer
6 - Spacer
7 - Washer - Fiber
8 - Lockwasher - Double Wound
9 - Locknut
10 - Washer
11 - Locknut
12 - Shift Cable Outer Casing
13 - End Guide
14 - Core Wire Anchor
15 - Anchor Screws
16 - Core Wire
17 - Shift Slide
18 - Screw - Core Wire Cavity
19 - Gimbal Housing Eyelet
20 - Cable Wrapping

Torque Specifications

a - 25 lb-ft (34 Nm)
b - 37 lb-ft (50 Nm)

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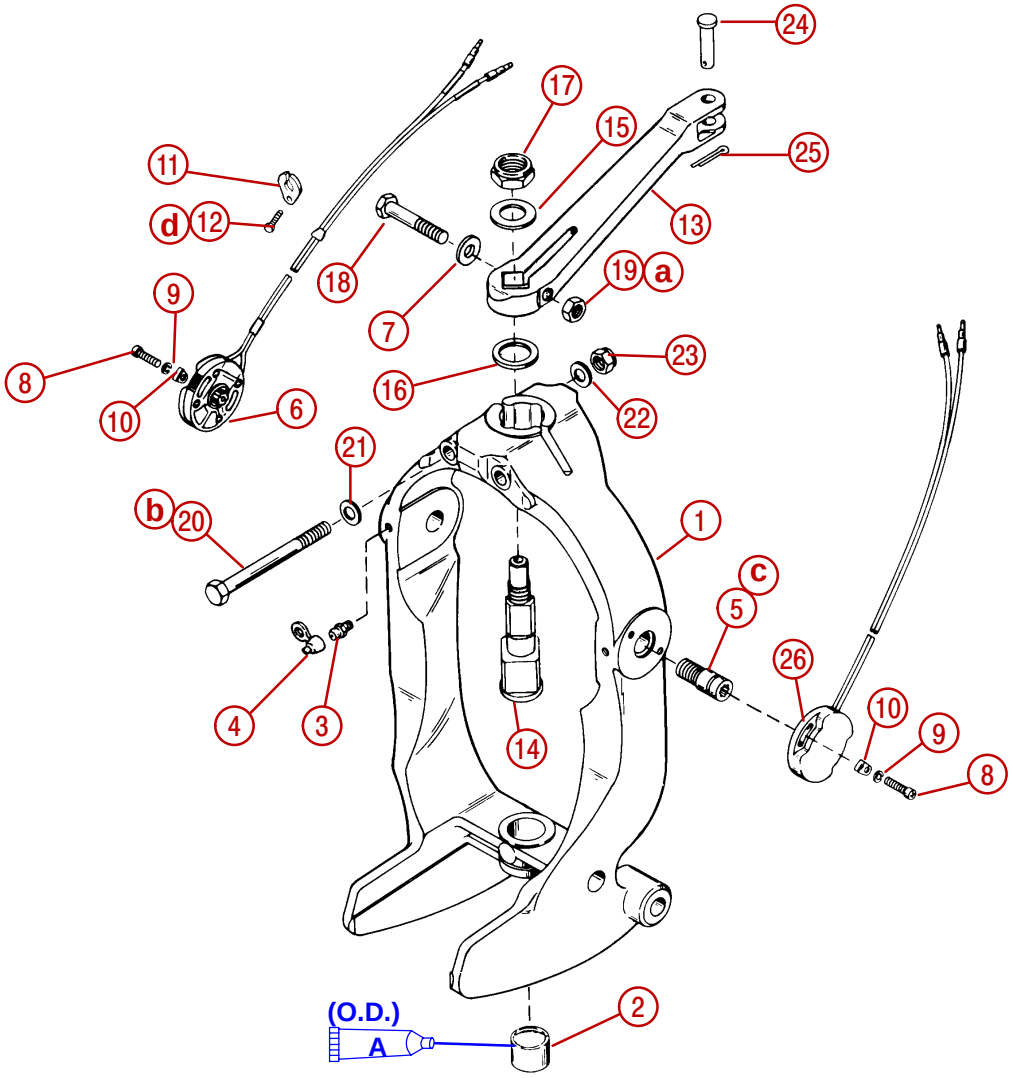
Gimbal Ring and Steering Lever Components



1 - Gimbal Ring
2 - Bushing
3 - Grease Fitting
4 - Lubricap
5 - Hinge Pin
6 - Trim Limit Switch
7 - Washer
8 - Screw
9 - Lockwasher
10 - Retainer
11 - Trim Wire Clamp
12 - Screw
13 - Steering Lever
14 - Swivel Shaft
15 - Washer
16 - Washer
17 - Nut
18 - Screw
19 - Nut
20 - Screw
21 - Washer
22 - Washer
23 - Locknut
24 - Clevis Pin
25 - Cotter Pin
26 - Trim Position Sender

Lubricants/Sealers/Adhesives

- Resiweld Sealer

Torque Specifications

c - 60 lb-ft (81 Nm)
d - 55 lb-ft (74 Nm)
e - 110 lb-ft (148 Nm)
f - 95 lb-in. (10.5 Nm)

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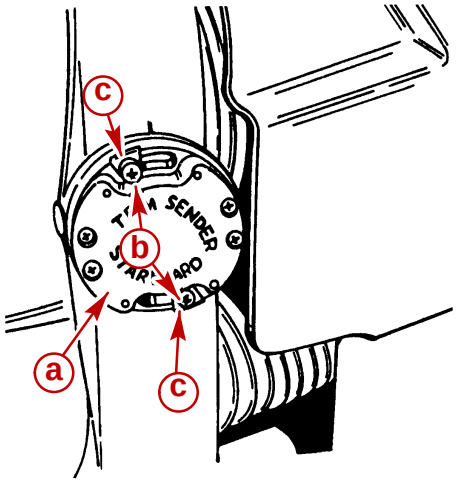
Component Disassembly

Bell Housing Removal

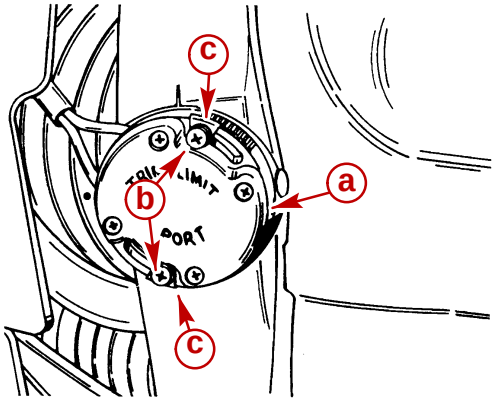
1. Remove sterndrive unit.
2. Remove trim position sender.



71220

a - Trim Position Sender
b - Screws (2) and Washers (2)
c - Retainers (2)

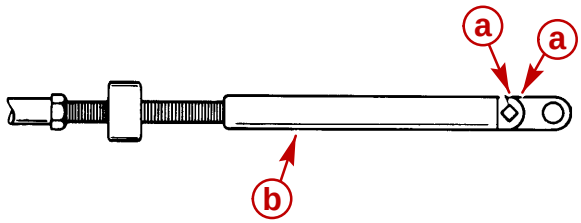
3. Remove trim limit switch.



71221

a - Trim Limit Switch
b - Screws (2) and Washers (2)
c - Retainers (2)

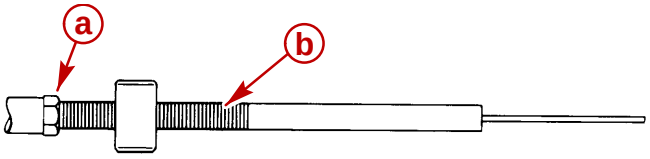
4. Disconnect shift cable from shift plate and remove cable end guide (b) by loosening anchor screws (a).



22183

a - Anchor Screws (2)
b - End Guide

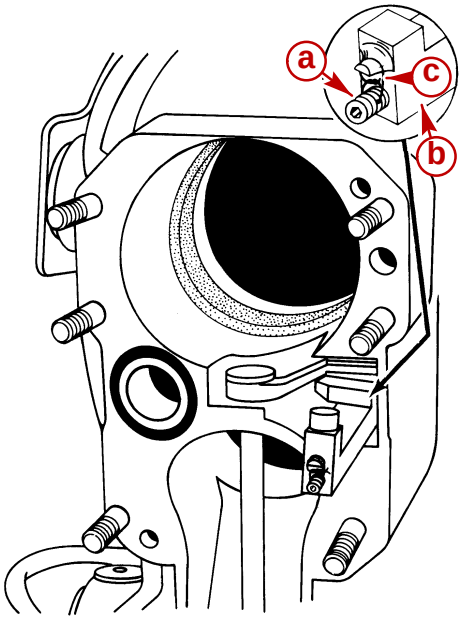
5. Remove threaded tube (b) by loosening locking nut (a).



22183

a - Jam Nut
b - Threaded Tube

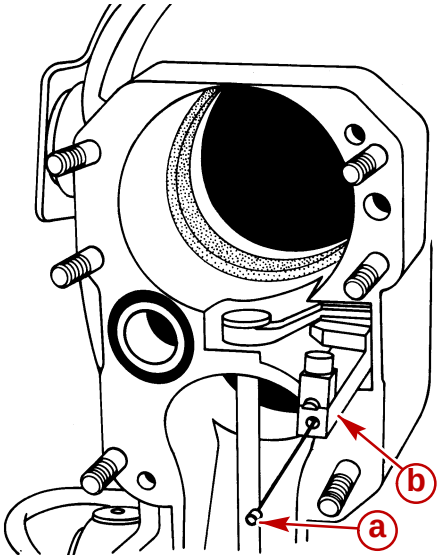
6. Remove lock wire and set screw from shift slide.



70139

a - Set Screw
b - Shift Slide
c - Safety Wire

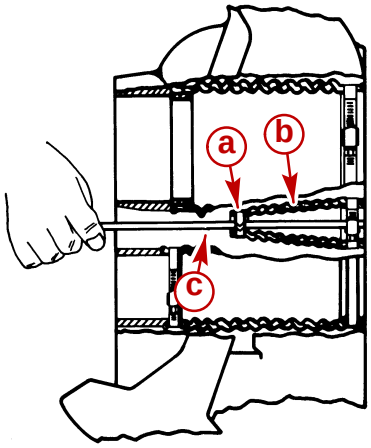
7. Remove inner core wire and shift slide.



70138

a - Inner Core Wire
b - Shift Slide

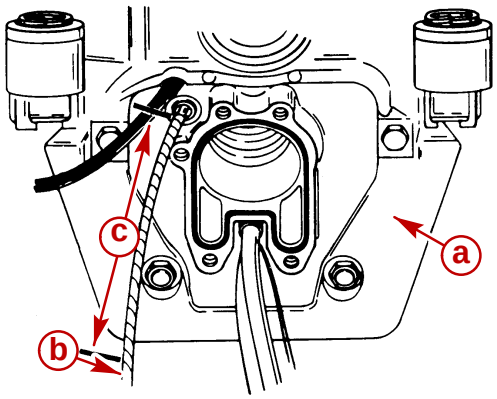
8. Remove and discard shift cable bellows crimp clamp.



70137

a - Crimp Clamp
b - Shift Cable Bellows
c - Shift Cable

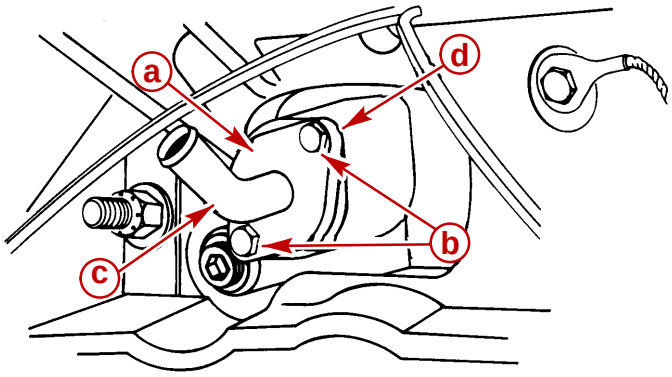
9. Remove shift cable wrapping from shift cable on inner transom.



22030

a - Inner Transom
b - Shift Cable
c - Wrapping

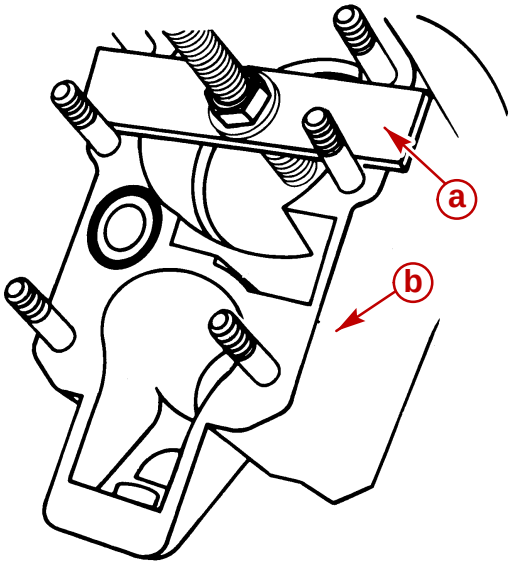
10. Remove water tube cover and rubber grommet. Push water tube through gimbal housing.



70149

a - Water Tube Cover
b - Screws
c - Water Tube
d - Rubber Grommet (Beneath Cover)

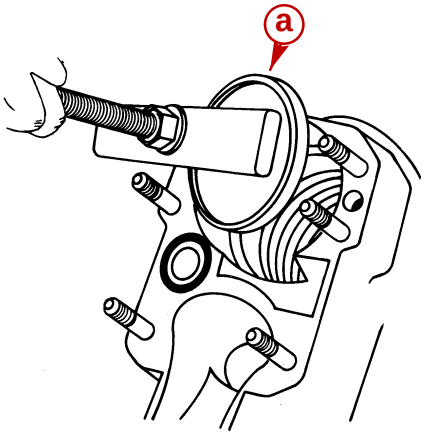
11. Insert removal tool into U-joint bellows and tighten nut until sleeve becomes dislodged from bellows.



70178

a - Removal Tool (91-818169)
b - Bell Housing

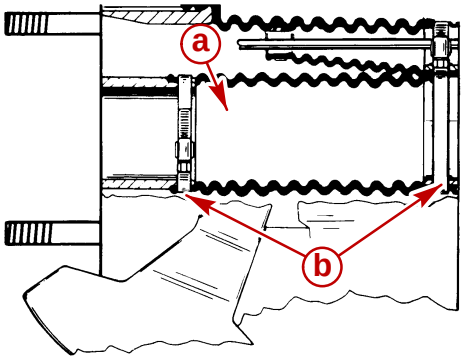
12. Remove sleeve from universal joint bellows.



70179

a - Sleeve

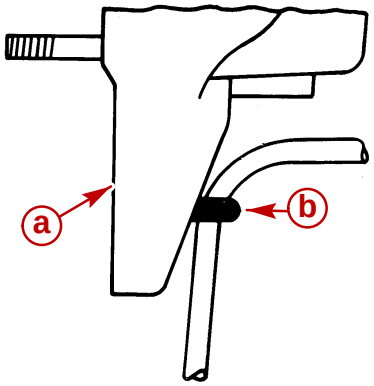
13. Loosen exhaust bellows clamps and remove bellows.



22116

a - Exhaust Bellows
b - Hose Clamps

14. Remove speedometer tubing clip from bell housing.

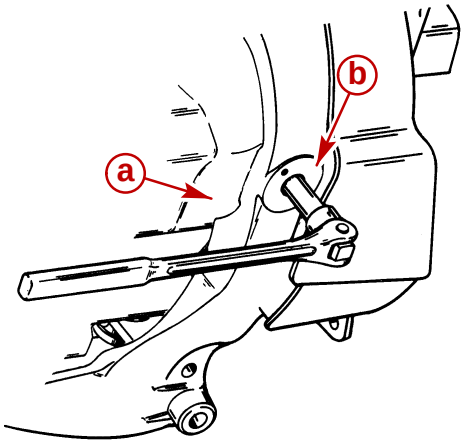


70196

a - Bell Housing
b - Speedometer Tubing Clip

15. Remove continuity wire from port side of bell housing.

16. Remove hinge pins.



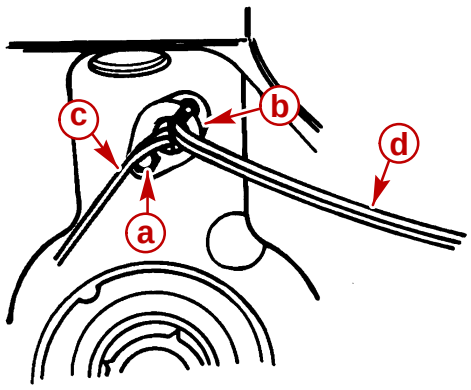
22113

a - Bell Housing
b - Hinge Pins - Remove (Port And Starboard)
c - Hinge Pin tool (91-78310)

17. Remove bell housing.

Trim Position Sender and Trim Limit Switch Wire Removal

1. Remove trim limit switch wires and trim position sender wires.



70197

a - Screw
b - Trim Harness Clamp - Remove
c - Trim Limit Switch Wires
d - Trim Position Sender Wires

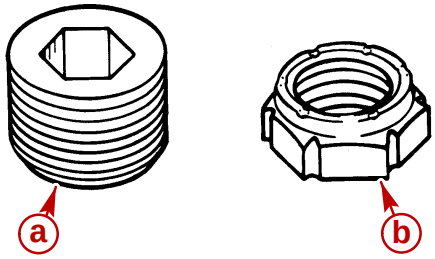
Gimbal Ring, Swivel Shaft and Steering Lever Removal

GIMBAL HOUSING ACCESS PLUG

This kit, available for use on MerCruiser Transom assemblies, allows for removal and installation of gimbal ring without having to remove engine and transom assembly. A template is also included in this kit to locate access holes.

NOTE: *If steering lever cavity is not accessible, it will be necessary to drill access holes in gimbal housing. This procedure requires the following:*

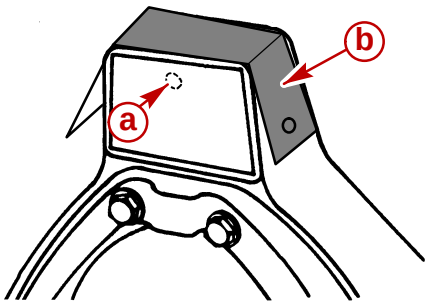
Access Plug Kit 22-88847A-1
1-1/8 in. Hole Saw (obtain locally)
1 in. NPT Pipe Tap #180 (obtain locally)



26409

a - Plastic Plugs (2)
b - Swivel Shaft Nut

1. Use template at the end of this section as a guide for the correct location for cutting and drilling access holes. Align template with dimple located beneath decal on the gimbal housing.



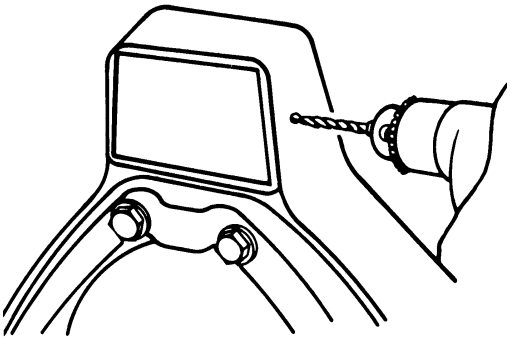
70862

a - Dimple (Beneath Decal)

⚠ CAUTION

Be sure to drill and cut hole and tap threads perpendicular to gimbal housing surfaces in the following steps.

2. Drill pilot holes (port and starboard) using a drill that is the same size as the pilot rod being supplied with the hole saw (approximately 1/4 in.) (6 mm).

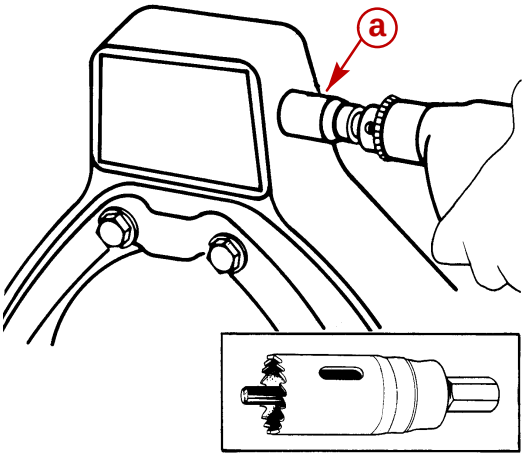


70152

⚠ CAUTION

Eye Protection must be worn when performing the following procedure. Failure to do so may cause personal injury.

3. Cut holes in gimbal housing (port and starboard) using 1-1/8 in. hole saw and pilot rod. Remove metal chips with compressed air.

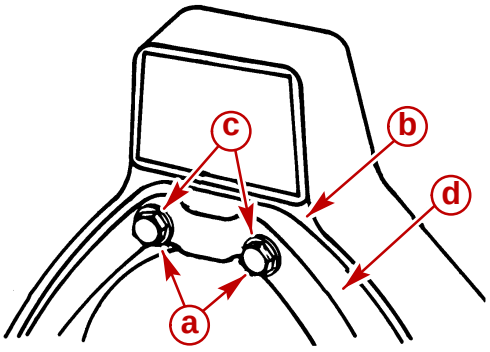


70153 22652

a - Drill Pilot Hole

REMOVAL

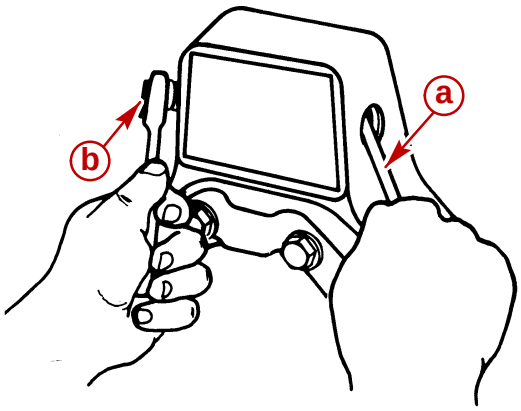
1. Loosen screws and nuts (not necessary to remove).



70150

a - Screws (2)
b - Nuts (2)
c - Washers (4)
d - Gimbal Ring

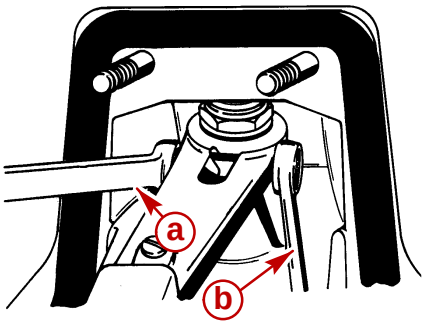
2. Loosen steering lever clamping bolt and nut.



70157

With Engine And Transom Assembly Installed

a - Wrench
b - Socket Wrench

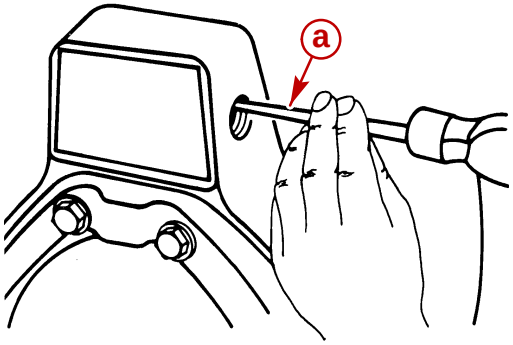


22460

With Engine And Transom Assembly Removed

a - Wrench
b - Wrench

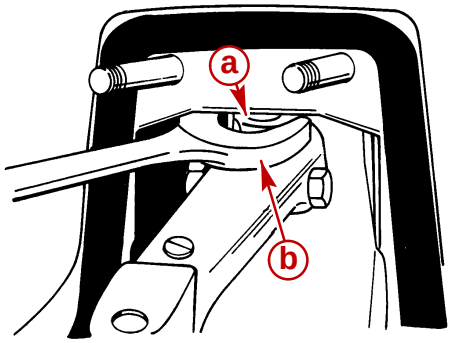
3. Unthread elastic locknut.



70156

With Engine And Transom Assembly Installed

a - Pin Punch

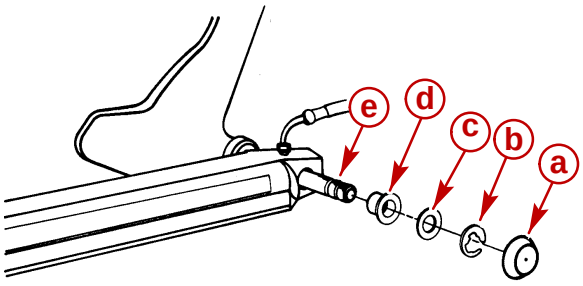


22452

With Engine And Transom Assembly Removed

a - Locknut
b - 1-1/16 in. Wrench

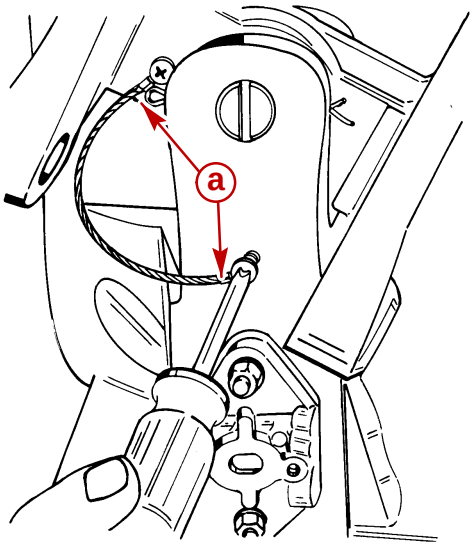
4. Disconnect trim cylinders from gimbal ring (if not already done). Suspend cylinders to avoid damage to hoses using care not to break the continuity wires.



70176

a - Plastic Cap
b - Clip
c - Flat Washer
d - Bushing
e - Anchor Pin

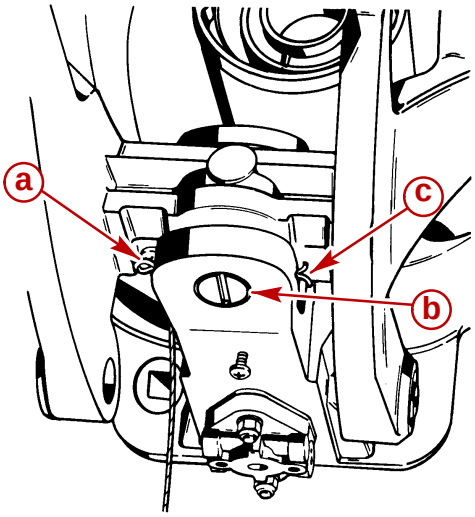
5. Disconnect continuity wire.



22261

a - Continuity Wire

6. Remove cotter pin, lower swivel pin and anti-gauling washer.

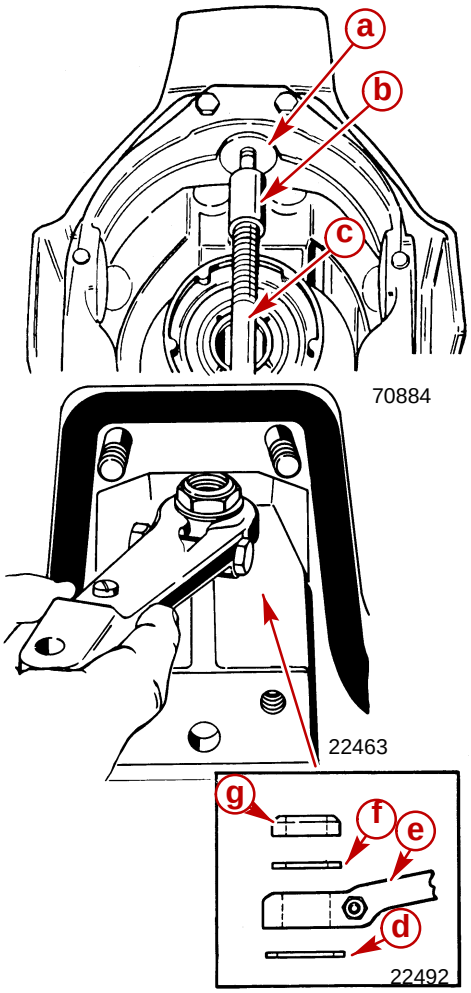


22461

a - Cotter Pin
b - Lower Swivel Pin
c - Washer (anti-gauling)

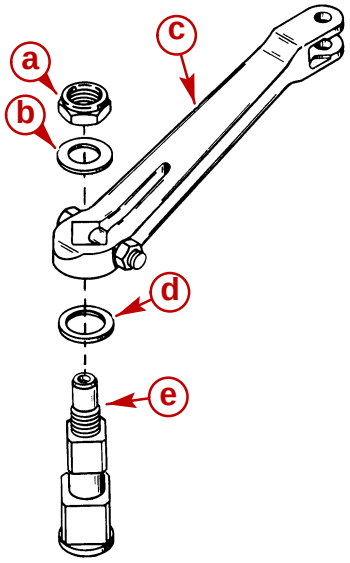
7. Remove upper swivel shaft from gimbal ring, large I.D. washer, steering lever, small I.D. washer, and locknut.

IMPORTANT: If swivel shaft is seized, remove shaft using Slide Hammer Puller (91-34569A1) and Puller Head (91-63616). Bell housing and bellows must be removed.



a - Swivel Shaft
b - Puller Head
c - Slide Hammer Puller
d - Large I.D. Washer
e - Steering Lever
f - Small I.D. Washer
g - Locknut

8. Remove upper swivel shaft, steering lever and hardware shown. Remove gimbal ring.



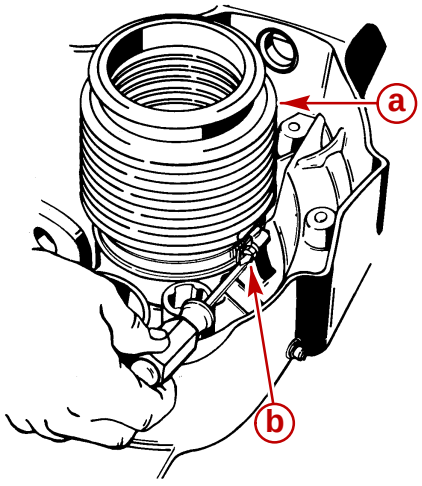
23293

a - Nut
b - Washer (Small I.D.)
c - Steering Lever
d - Washer (Large I.D.)
e - Upper Swivel Shaft

Gimbal Housing Servicing

U-Joint Bellows Removal

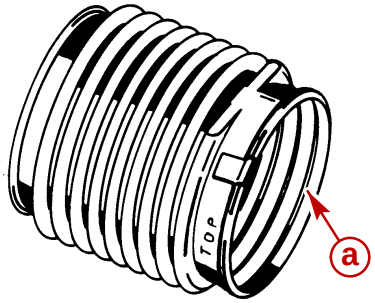
1. Remove U-joint bellows from gimbal housing.



50383

a - U-joint Bellows
b - Hose Clamp

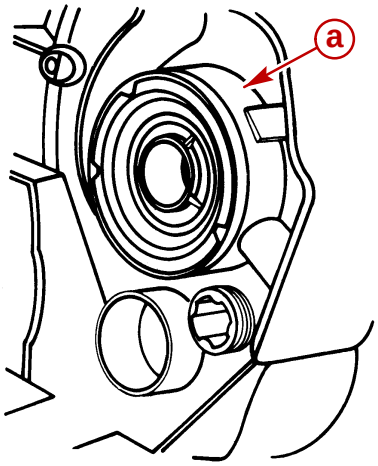
2. If reusing bellows, remove old adhesive from inside diameter of U-joint bellows end using lacquer thinner, and inspect for possible damage.



50383

a - Bellows

3. Clean bellows mounting flange on gimbal housing with sandpaper and wipe clean with lacquer thinner.

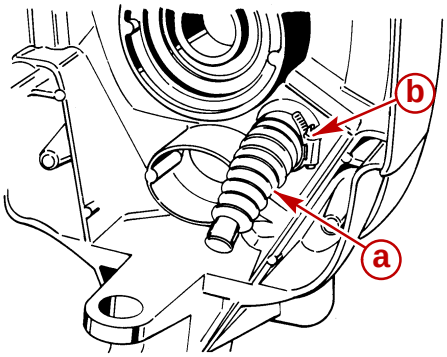


70184

a - Mounting Flange

Shift Cable Bellows Removal

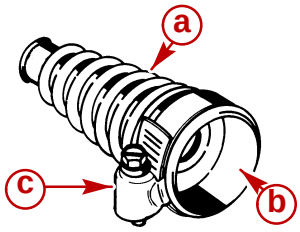
1. Loosen hose clamp and remove shift cable bellows.



50542

a - Shift Cable Bellows
b - Hose Clamp

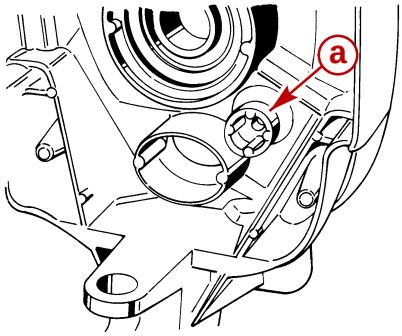
2. Clean old adhesive from shift cable bellows mounting surface using lacquer thinner, and inspect for possible damage.



22454

a - Shift Cable Bellows
b - Mounting Surface
c - Hose Clamp

3. Clean shift cable bellows mounting flange with a wire brush or sandpaper and wipe clean with lacquer thinner.

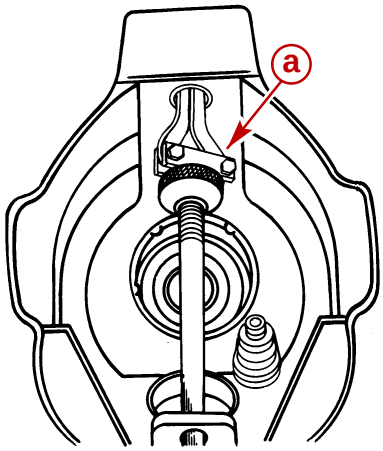


50542

a - Mounting Flange

Bushings And Upper Seal Removal

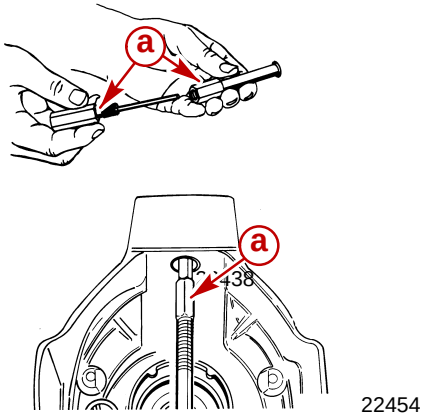
1. Remove oil seal and large bushing from gimbal housing using a two-jaw puller and slide hammer assembly.



70177

a - Two Jaw Puller And Slide Hammer Assembly

2. Remove small bushing from gimbal housing using a Bushing Removal Tool. (Snap On Tool Company P/N CG40CB)

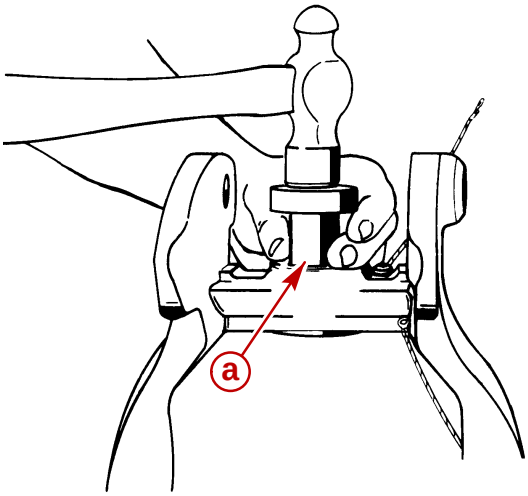


a - Bushing Removal Tool (Snap On Tool Company P/N CG40CB)

⚠ CAUTION

Be careful not to damage bores when removing self-lubricating bushings in the following steps.

3. Remove gimbal ring lower swivel pin bushing using a suitable mandrel.

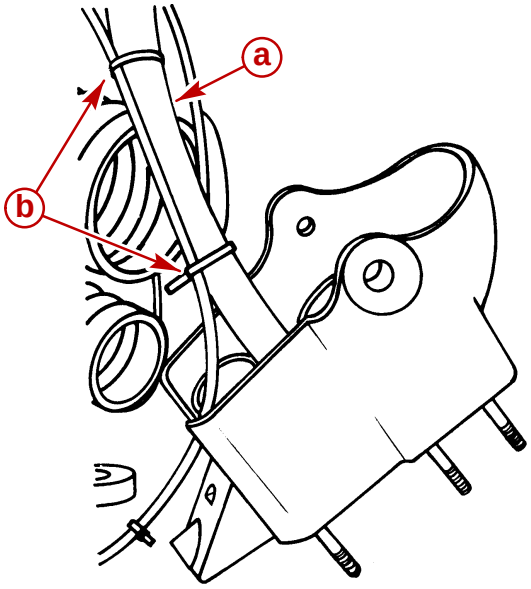


a - Suitable Mandrel - Tap Out Lower Swivel Pin Bushing

Component Servicing

Bell Housing Disassembly

1. Pull bell housing away from gimbal housing and remove plastic clips from water hose.

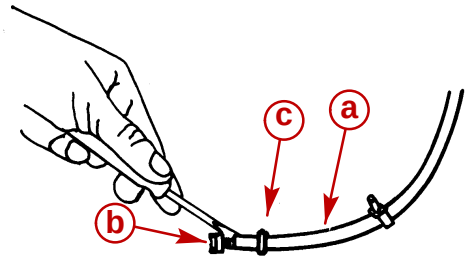


70202

a - Water Hose
b - Plastic Clips

2. Loosen or cut small sta-strap around speedometer fitting. Remove speedometer fitting from tubing.

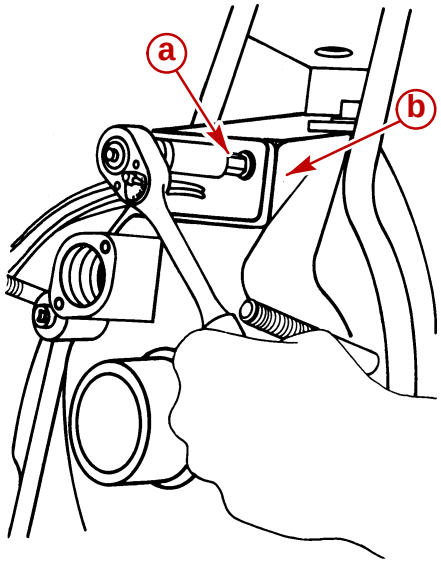
NOTE: *It may be necessary to loosen hose in hot water to enable removal of speedometer fitting.*



70200

a - Tubing
b - Speedometer Fitting
c - Sta-strap

3. Disconnect speedometer hose at transom and remove fitting and hose from unit.

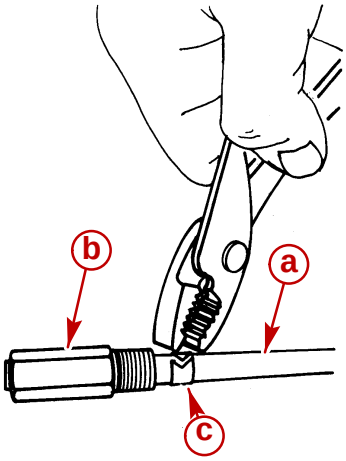


70203

a - Fitting
b - Gimbal Housing

4. Remove clamp and fitting from tubing.

NOTE: *It may be necessary to loosen hose in hot water to enable removal of fitting.*

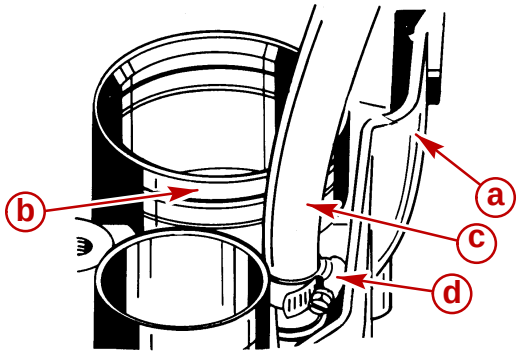


70201

a - Tubing
b - Fitting
c - Clamp

5. Remove water inlet hose from bell housing.

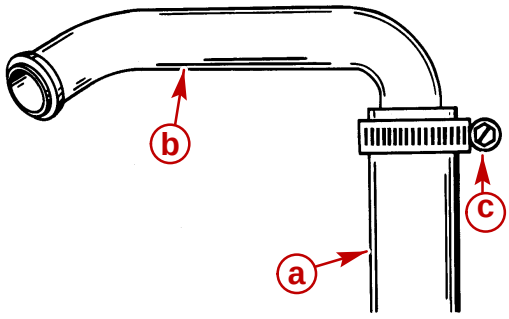
6. Clean bell housing mounting flange with a wire brush or sandpaper. Wipe clean with lacquer thinner.



23361

a - Bell Housing
b - Mounting Flange
c - Water Tube
d - Hose Clamp

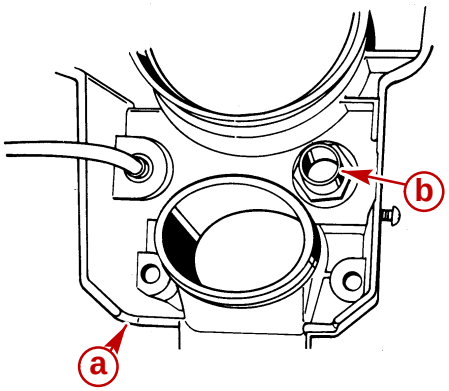
7. Loosen hose clamp and remove water tube from water hose.



23294

a - Water Hose
b - Water Tube
c - Hose Clamp

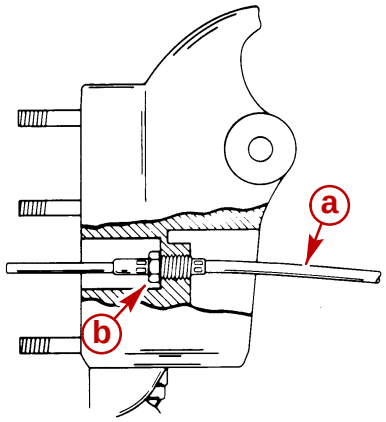
8. Remove water hose connector from bell housing.



50543

a - Bell Housing
b - Water Hose Connector

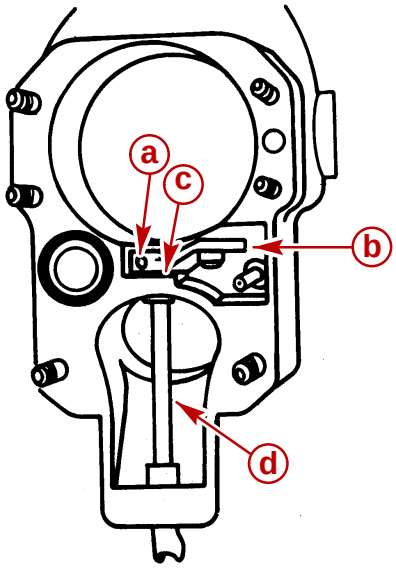
9. Loosen shift cable using Shift Cable Removal And Installation Tool and remove shift cable.



23156

a - Shift Cable
b - Retaining Nut - Use Tool (91-12037)

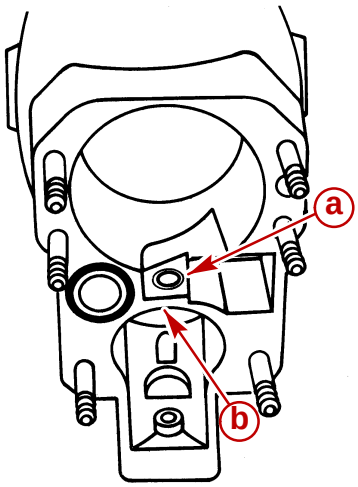
10. Remove upper shift shaft lever and shift shaft.



70141

a - Upper Shift Shaft Lever Screw
b - Upper Shift Shaft Lever
c - Washer (Beneath Lever)
d - Upper Shift Shaft

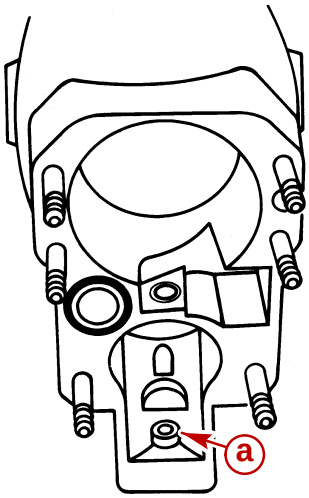
11. Remove shift shaft upper bushing.



70182

a - Upper Bushing
b - Bushing (Below Seal)

12. Remove shift shaft lower bushing.

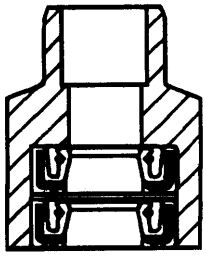


70182

a - Bushing

Bell Housing Reassembly

All units built with serial numbers from 0D644651 to 0F094774 will have the following bushing installed. The seals were previously installed into the bell housing upper bore. They now are already installed in the bushing and can be installed with one procedure using Bushing Tool 91-805057A2.



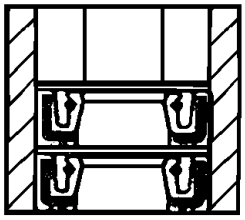
23-805041A2 71227

Earlier Model Bushing and Seals

NOTE: *It may be necessary to apply heat to shift shaft lever screw to aid in removing.*

NOTE: *The inner diameter of the later model bushing is much larger than the shift shaft.*

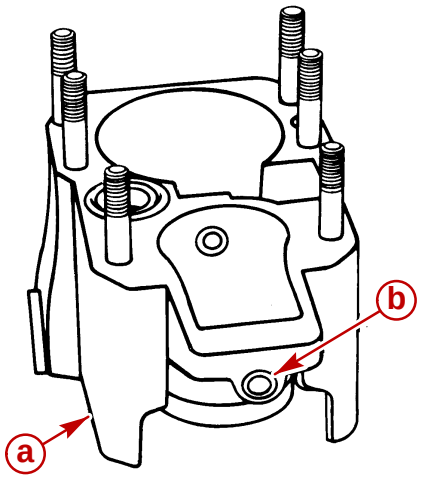
All units with serial number 0F094775 and above have the following bushing and seal arrangement. Use Bushing Installation Tool 91-806928 A1 to install the later model bushing and seals.



74116

Later Model Bushing and Seals

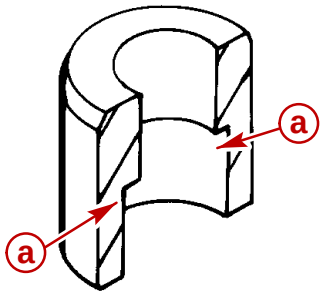
1. **Earlier Model Bushing and Seal:** Apply a small amount of Special Lubricant 101 to O.D. of shift shaft lower bushing. Install bushing flush with bottom of the bore in bell housing. (On units with later model bushing and seal arrangement, install the lower bushing in Step 6.)



70181

a - Bell Housing
b - Bushing

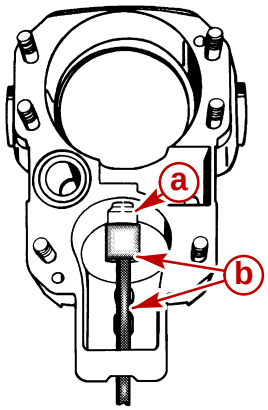
2. **Later Model Bushing and Seal:** Use installation tool 91-806928T to install lower bushing flush with the bottom of the bore in the bell housing.



74117

a - Relief Cut Out

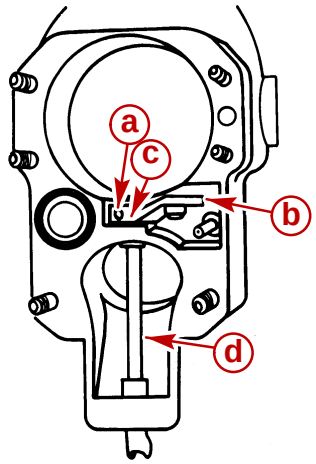
3. **Both Models:** Apply Lubricant 101 to O.D. of bushing and install shift shaft upper bushing in bore from bottom using appropriate bushing installation tool. **Later Model Bushing and Seal:** Install the upper bushing and seals individually.



70982

a - Upper Bushing
b - Bushing Installation Tool (91-805057A2)

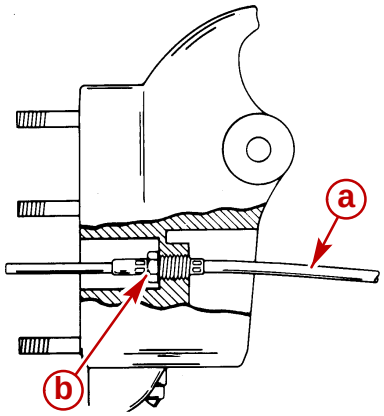
4. Install upper shift shaft lever and shift shaft. Apply Loctite 27131 or Type “A” to screw threads. Tighten securely.



70141

a - Upper Shift Shaft Lever Screw
b - Upper Shift Shaft Lever
c - Washer (Beneath Lever)
d - Upper Shift Shaft

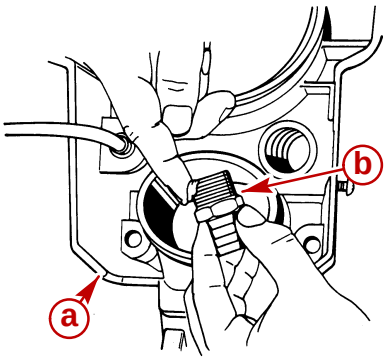
5. Apply Perfect Seal to threads of shift cable retainer and install shift cable. Tighten retainer securely using shift cable removal and installation tool (until no more than two threads of retainer are showing).



23156

a - Shift Cable
b - Retaining Nut - Use Tool (91-12037)

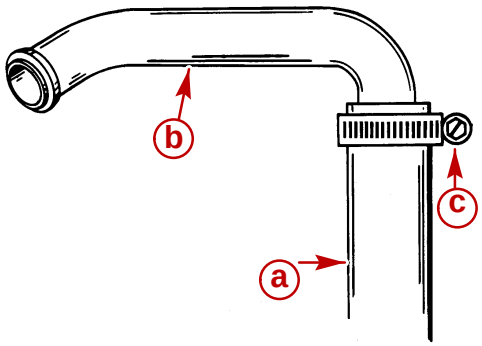
6. Apply Perfect Seal to threads of water hose connector and install in bell housing. On earlier style, tighten securely. Later models have connector casted in.



50543

a - Bell Housing
b - Water Hose Connector

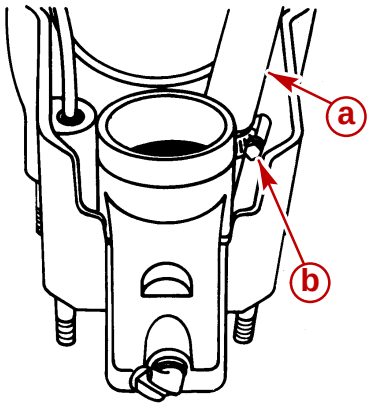
7. Connect water hose to water tube and position hose clamp as shown. Tighten securely.



23294

a - Water Hose
b - Water Tube
c - Hose Clamp

8. Connect water hose to connector on bell housing. Position hose and clamp as shown. Tighten securely.



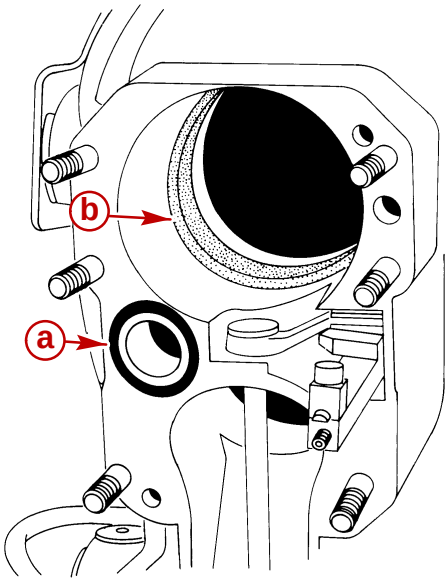
70170

a - Water Hose
b - Hose Clamp

Gasket And O-Ring

1. Install U-joint bore rubber gasket and water passage O-ring.

NOTE: *It may be necessary to apply 3M Adhesive to help hold the rubber gasket in place.*



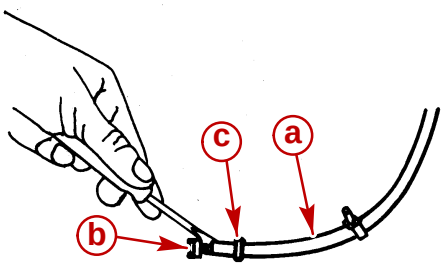
70022

a - O-ring
b - Rubber Gasket

Speedometer Tubing And Water Hose

1. Replace fitting inside speedometer tubing and secure in place with a small sta-strap.

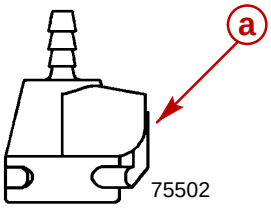
NOTE: *It may be necessary to soften hose in hot water before replacing fitting.*



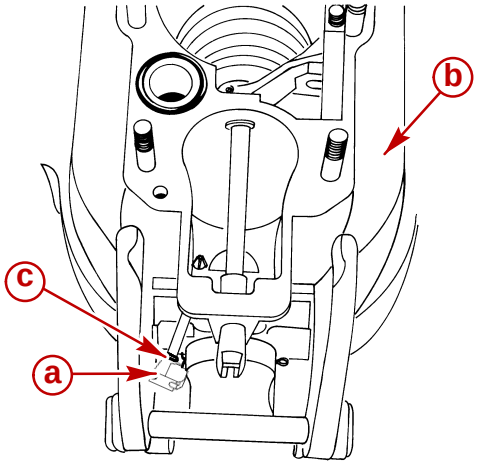
70200

1997 1/2 And Earlier Model Speedometer Connector

a - Tubing
b - Fitting
c - Sta-strap



75502

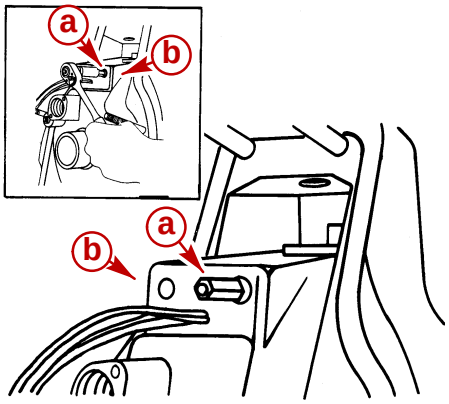


75581

1998 Model Speedometer Connector

a - Topside Portion, Female End
b - Bell Housing
c - Sta-Strap

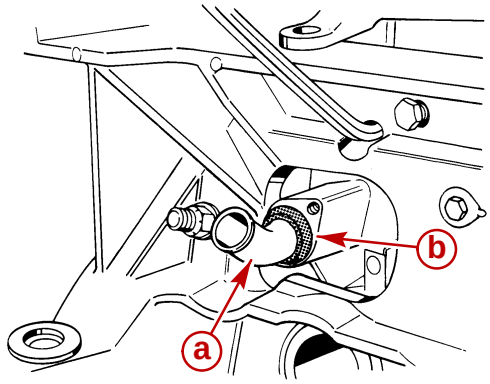
2. Apply Perfect Seal to threads of brass fitting. Tighten fitting securely into gimbal housing.



70204

a - Brass Fitting (Apply Perfect Seal)
b - Gimbal Housing

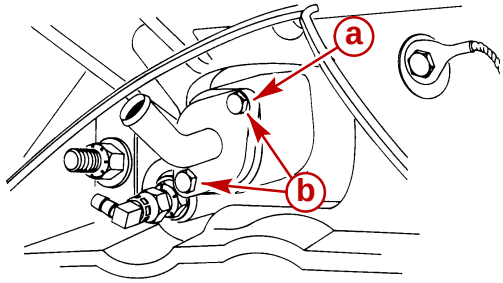
3. Replace sta-strap on the hose at the connector.
4. Install water tube through gimbal housing and install rubber grommet over tube. Push grommet into cavity.



50544

a - Water Tube
b - Rubber Grommet

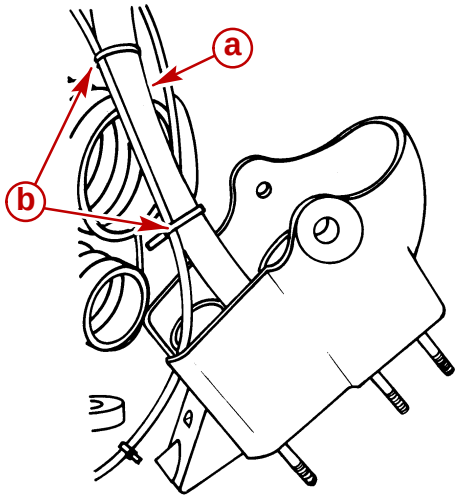
5. Install water tube cover and tighten screws securely.



70149

a - Water Tube Cover
b - Screws

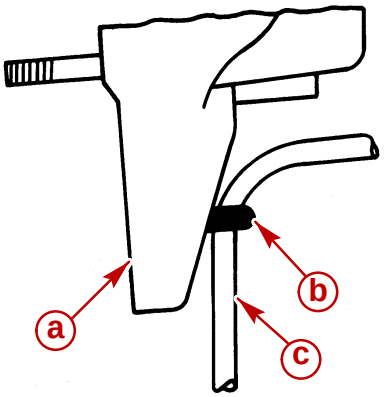
6. Secure tubing to water hose using sta-straps. **Do not** overtighten or kink tubing.



70202

a - Water Hose
b - Sta-straps

7. Replace speedometer tubing clip onto tubing and replace in hole in bell housing.



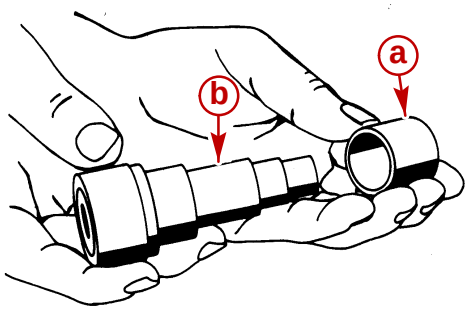
70196

a - Bell Housing
b - Tubing Clip
c - Speedometer Tubing

Reassembly

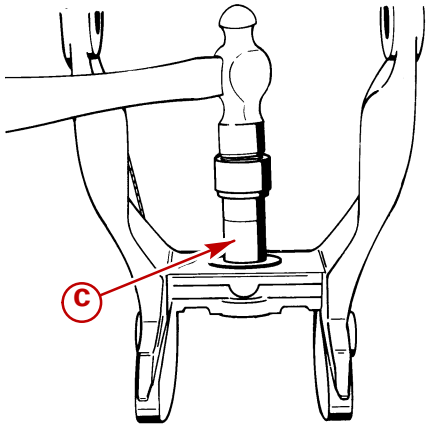
Gimbal Ring Bushing Installation

1. Install gimbal ring lower swivel pin bushing as follows:
   a. Apply Resiweld Sealer (92-65150-1) to O.D. of bushing (a) and position bushing on bearing and seal driver (b).



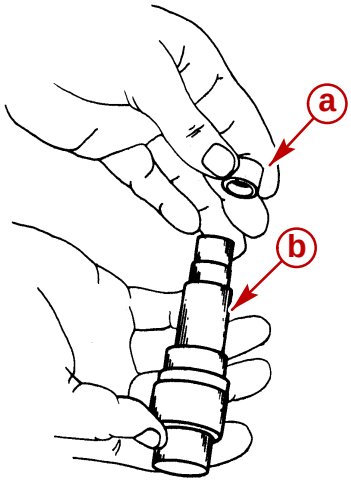
22440

   b. Inspect bore for cleanliness and damage before installing bushing.
   c. Install bushing in gimbal ring (c) by pressing or tapping in place with a brass hammer. (Pressing is preferred).



22453

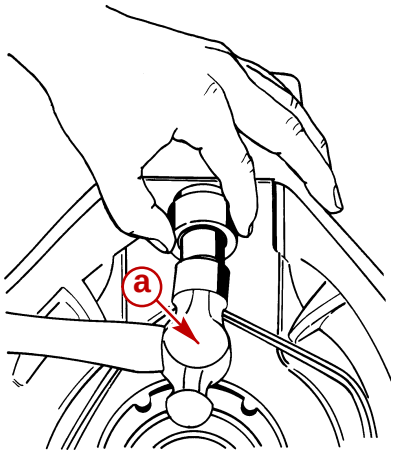
2. Install upper swivel shaft small bushing as follows:
   a. Place bushing on bearing and seal driver.



70185

a - Small Bushing
b - Seal Driver

b. Install bushing by tapping it in place with a brass hammer.

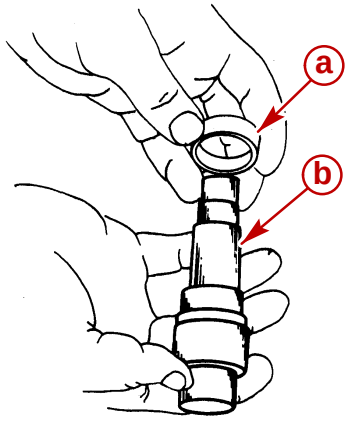


22450

a - Brass Hammer

3. Install upper swivel shaft large bushing as follows:

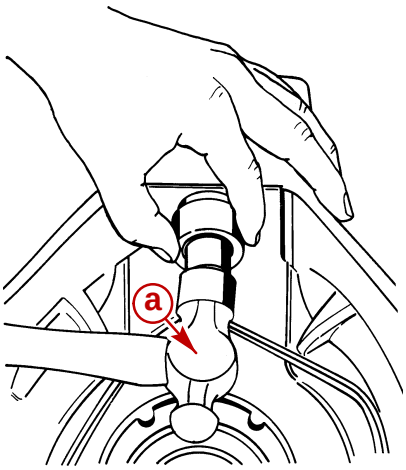
a. Place bushing on bearing and seal driver.



70187

a - Large Bushing
b - Seal Driver

b. Install bushing by tapping it in place with a brass hammer.

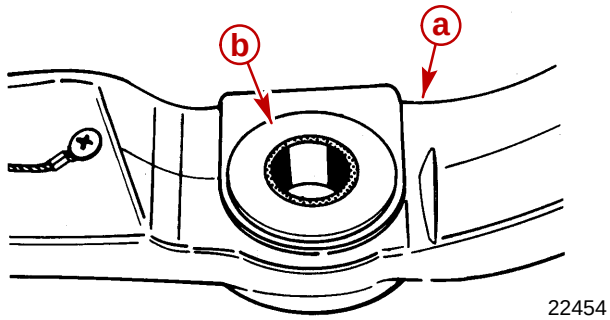


22450

a - Brass Hammer

SYNTHANE WASHERS

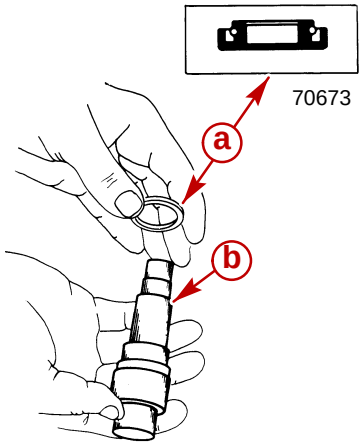
1. If synthane washers are worn, remove and clean any excess adhesive from surface. Peel backing off of washer and apply to gimbal ring.



a - Gimbal Ring
b - Synthane Washer (Port and Starboard)

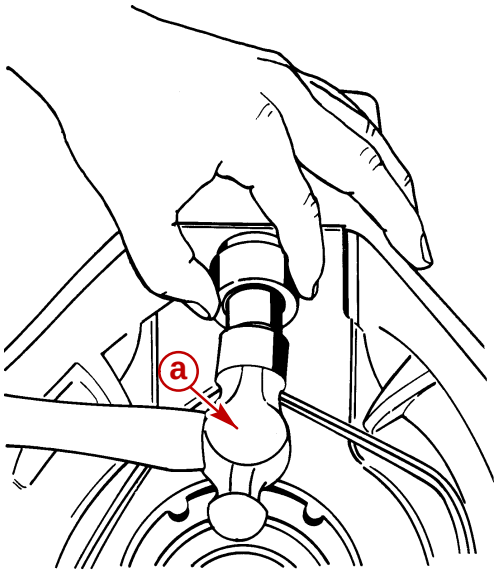
Oil Seal Installation

1. Install upper swivel shaft oil seal as follows:
   a. Place oil seal on bearing and seal driver with lip facing the small diameter end of tool. Apply Loctite 271 to O.D. of seal.



a - Oil Seal
b - Seal Driver

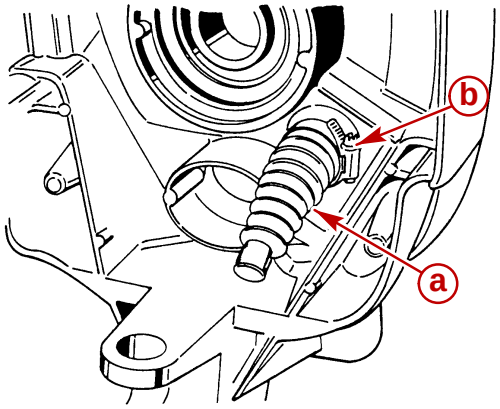
b. Install oil seal by tapping it in place with a brass hammer.



22450

a - Brass Hammer

2. Install shift cable bellows on gimbal housing. Position hose clamp as shown. Tighten securely.

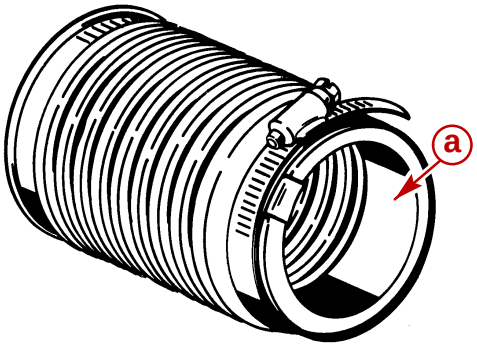


50542

a - Shift Cable Bellows
b - Hose Clamp

Exhaust Bellows Installation

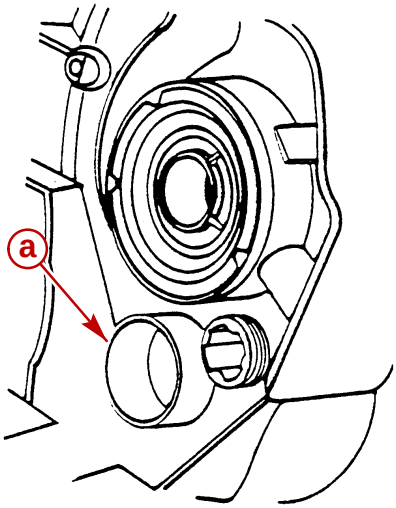
1. If old exhaust bellows will be reinstalled, remove old adhesive from exhaust bellows mounting surfaces, using lacquer thinner, and inspect for possible damage.



22450

a - Exhaust Bellows Mounting Surface

2. Clean exhaust bellows mounting flange with sandpaper and wipe clean with lacquer thinner.



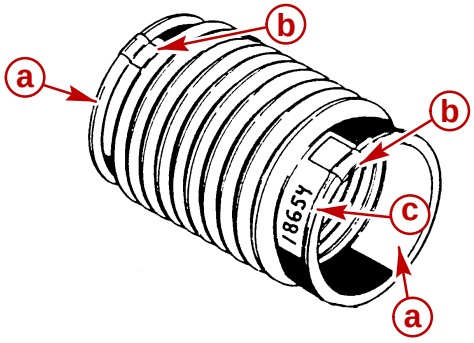
70184

a - Exhaust Flange

⚠ WARNING

Be sure to read and follow package label directions when using bellows adhesive.

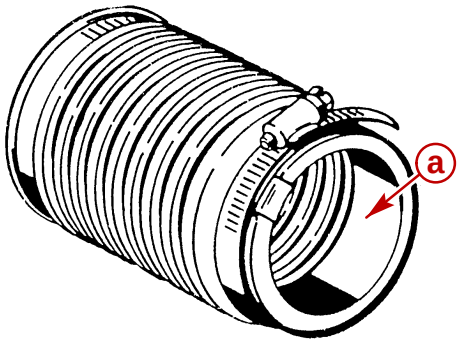
3. Position grounding clips on bellows. Use bellows P/N 18654 only.



22079

a - Apply 3M Brand Adhesive
b - Grounding Clips
c - Bellows Part Number

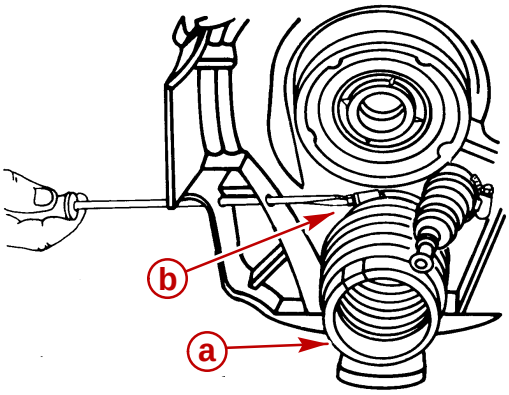
4. Apply bellows adhesive to exhaust bellows mounting surface. Allow to dry (approximately 10 minutes), before installing.



22450

a - Exhaust Bellows Mounting Surface

5. Install exhaust bellows on gimbal housing flange. Position hose clamp as shown. Torque to 30-40 lb-in. (3.3-4.5 Nm).

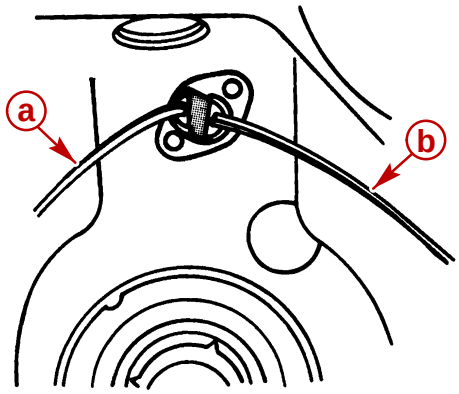


70199

a - Gimbal Housing Flange
b - Hose Clamp

Trim Position Sender and Trim Limit Switch Wire Installation

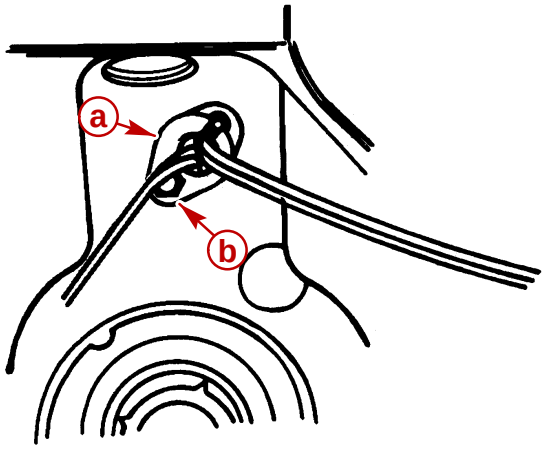
1. Install trim limit switch wires and trim position sender wires. DO NOT pinch wires.



70198

a - Trim Limit Switch Wires
b - Trim Position Sender Wires

2. Apply Perfect Seal to threads of screw and install trim harness clamp and screw.

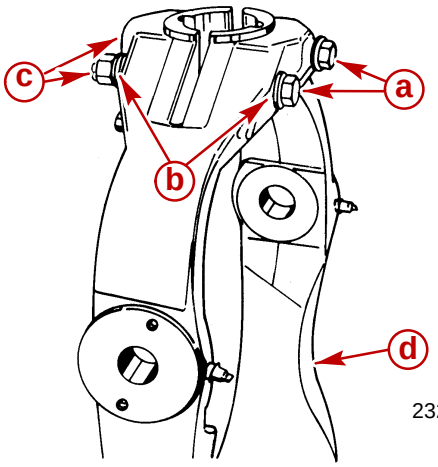


70197

a - Trim Harness Clamp
b - Screw-Torque 90-100 lb-in. (10.2-11.3 Nm)

Gimbal Ring, Swivel Shaft and Steering Lever Installation

1. If removed, install gimbal ring screws with hardware shown. Do not tighten.

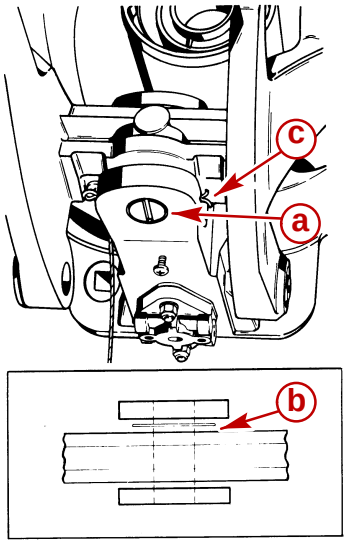


23293

23364

a - Gimbal Ring Screws (2)
b - Washers (4)
c - Nuts (2)
d - Gimbal Ring

2. Install lower swivel pin and washer and secure with cotter pin. Spread both ends.

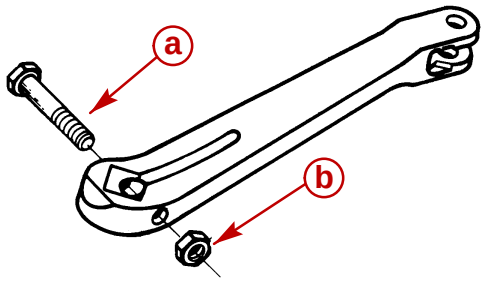


22461

22445

a - Lower Swivel Pin
b - Washer
c - Cotter Pin

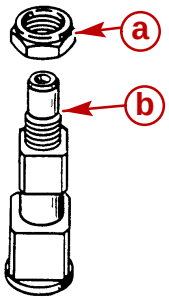
3. If removed, install clamping screw and nut on steering lever.



70189

a - Screw
b - Nut

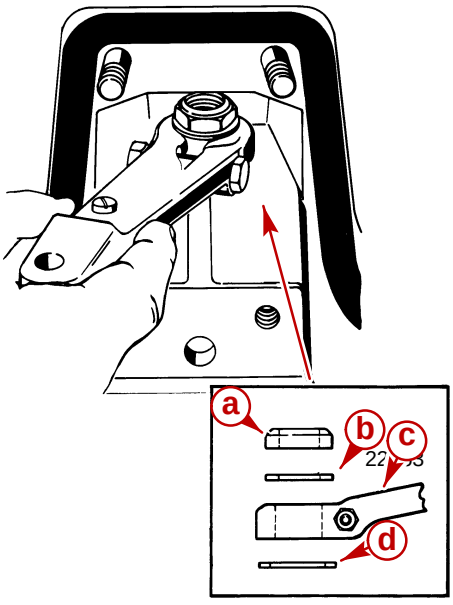
4. Thread new, grooved nut all the way onto swivel shaft to cut threads. Remove nut.



23293

a - Nut
b - Swivel Shaft

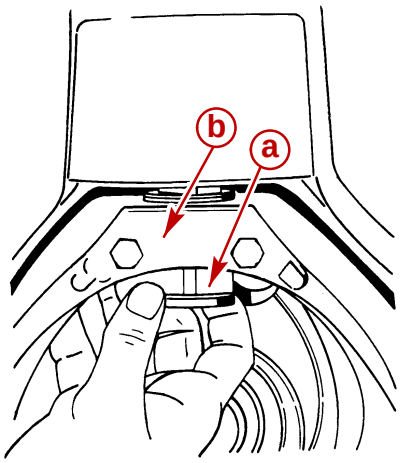
5. Place large I.D. washer, steering lever, small I.D. washer, and locknut into steering lever cavity in gimbal housing.



22492

a - Locknut
b - Small I.D. Washer
c - Steering Lever
d - Large I.D. Washer

6. Install upper swivel shaft through gimbal ring and up into and through washers, steering lever and locknut. Start locknut on upper swivel shaft threads. DO NOT tighten at this time.

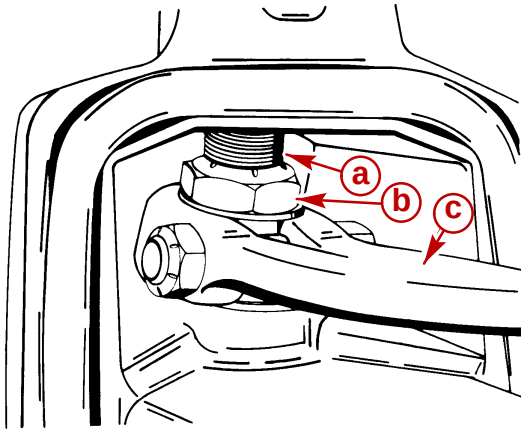


70885

a - Upper Swivel Shaft
b - Gimbal Ring

IMPORTANT: When installing upper swivel shaft through gimbal ring and steering lever, be sure that gimbal ring is straight and steering lever is pointed straight forward.

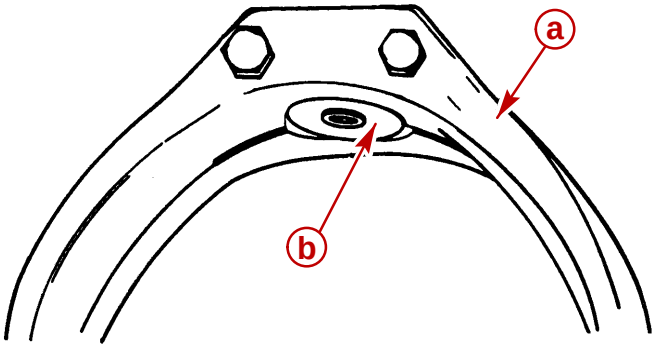
7. Install swivel shaft through gimbal rings and up through steering lever. Start nut on swivel shaft.



23362

a - Swivel Shaft
b - Nut
c - Steering Lever (Washer On Top And Bottom)

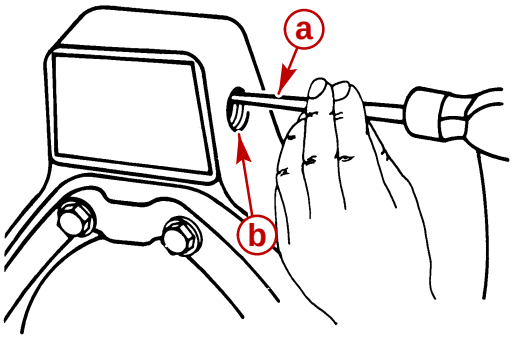
8. If installing new upper swivel shaft or gimbal ring, ensure that upper swivel shaft fits all the way into gimbal ring. Shoulder on shaft must rest against ring. If necessary, clean up mating surfaces with a file.



70886

a - Gimbal Ring
b - Upper Swivel Shaft

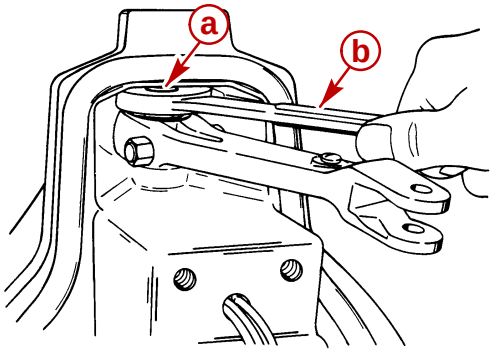
9. Tighten nut until a clearance of .002 - .010 in. (0.05 - 0.25 mm) exists between lower swivel pin washer and gimbal housing mount.



70156

Engine And Transom Assembly Installed

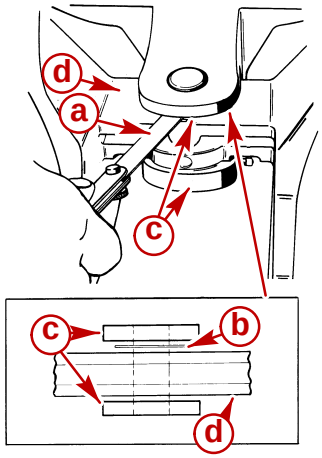
a - Pin Punch
b - Nut



50541

Engine And Transom Assembly Removed

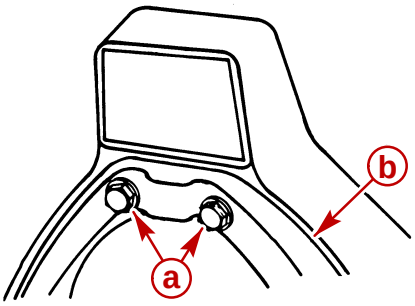
a - Nut
b - Wrench (1-1/16in.)



22445

a - Feeler Gauge - .001 - .010 in. (0.05 - 0.25 mm)
b - Washer
c - Gimbal Housing Mount
d - Gimbal Ring

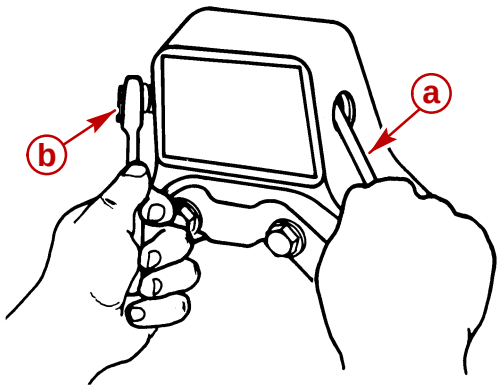
10. Strike down on gimbal ring flanges using a rawhide mallet. Recheck clearance and tighten swivel shaft nut as necessary.
11. Torque gimbal ring screws to 55 lb-ft (74 Nm).



70150

a - Screws (2) And Washers (2) Nuts (2) (Not Seen)
b - Gimbal Ring

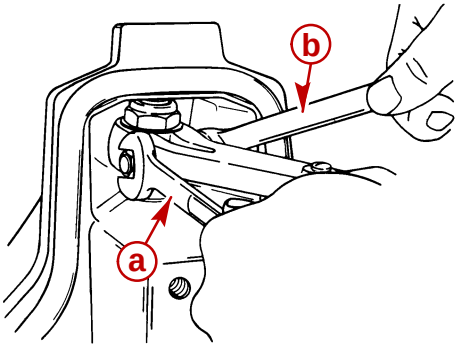
12. Tighten steering lever clamping screw and nut. Torque to 60 lb-ft (81 Nm).



70157

Engine And Transom Assembly Installed

a - Wrench
b - Socket Wrench

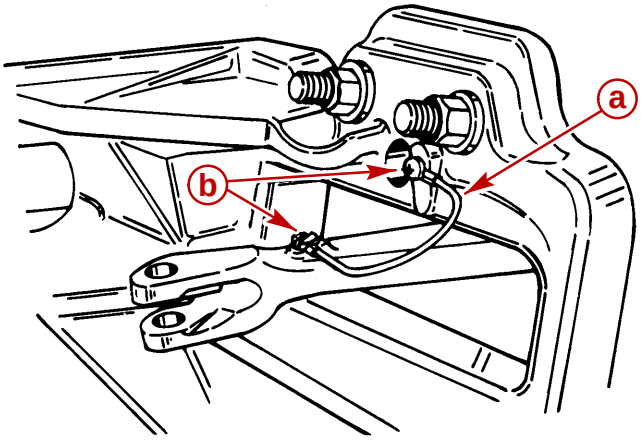


50541

Engine And Transom Assembly Removed

a - Wrench
b - Wrench

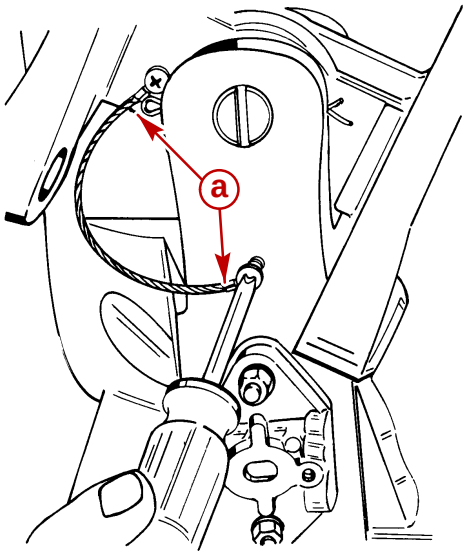
13. Install steering lever ground wire. Wire must be positioned exactly as shown.



22028

a - Ground Wire
b - Screws

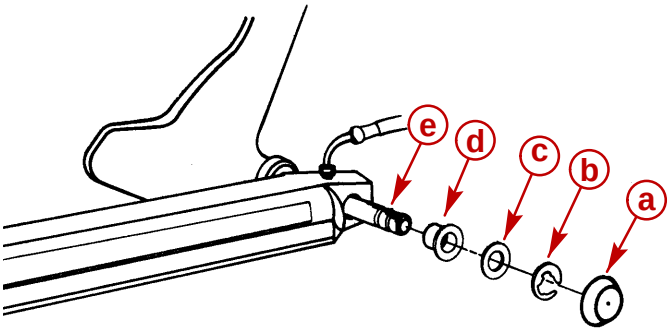
14. Connect continuity wire from gimbal housing to gimbal ring.



22261

a - Continuity Wire

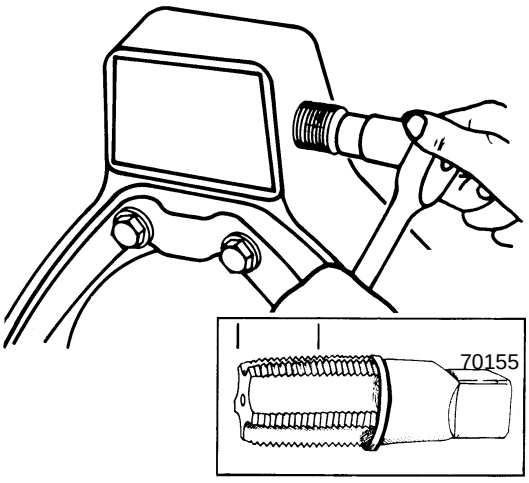
15. Install trim cylinders on gimbal ring.



70176

a - Plastic Cap
b - Clip
c - Flat Washer
d - Bushing
e - Anchor Pin

16. Mark 1 in. (25 mm) pipe tap with a piece of tape 1-1/8 in. (28 mm) from end of tap. Cut threads in access holes. Coat pipe tap with grease to aid in picking up metal chips.

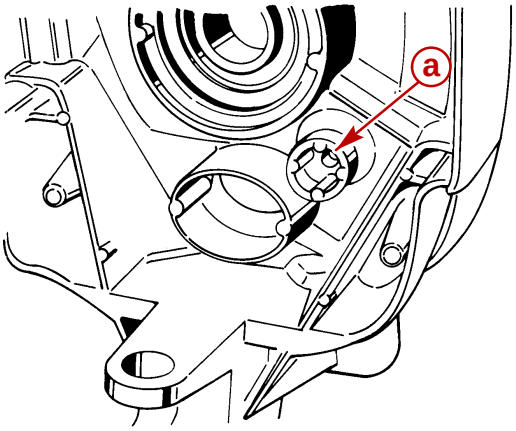


22757

17. Coat threads of plastic plugs (from kit) with Perfect Seal before installing into access hole. Install plug so that it is flush with gimbal housing.
18. Touch up any bare metal spots with primer and “Phantom Black” spray paint.

Shift Cable Bellows Installation

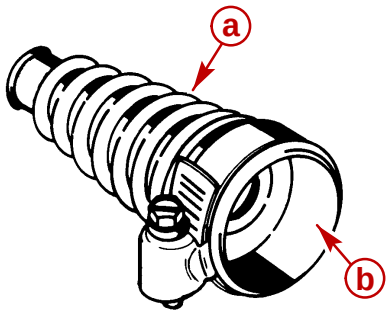
1. Clean shift cable bellows mounting flange with a wire brush or sandpaper and wipe clean with lacquer thinner.



50542

a - Mounting Flange

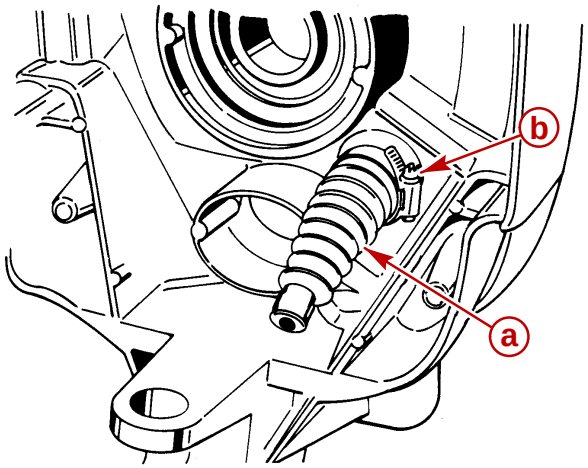
2. Apply adhesive to shift cable bellows mounting surface, using proper adhesive.



22454

a - Shift Cable Bellows
b - Mounting Surface

3. Install the shift cable bellows and tighten bellows clamp.

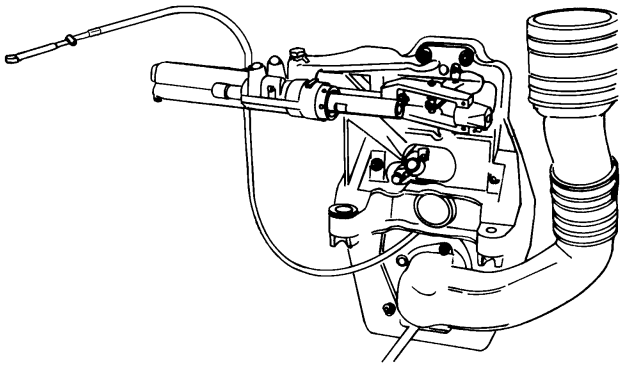


50542

a - Shift Cable Bellows
b - Hose Clamp

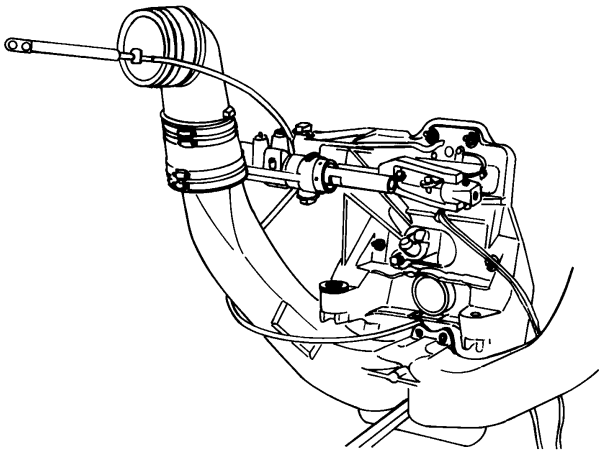
Bell Housing Installation

1. Prepare U-joint bellows for installation as follows:
   a. Clean gimbal housing mounting flange with sandpaper and wipe clean with lacquer thinner.
   b. Apply bellows adhesive to mounting surface on inside of bellows.
   c. Position grounding clip and hose clamp over bellows end.
2. Lubricate the end of the shift cable with Quicksilver 2-4-C Marine Lubricant with Teflon.
3. Carefully insert the cable through the small opening in the bellows and through the gimbal housing.
4. Then insert the cable into the engine compartment. Route the cable as shown in the following illustrations.



74903

3.0L Model



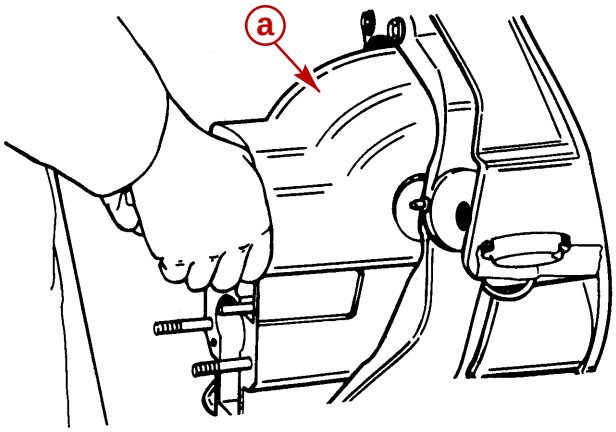
74901

V6 and V8 Models

⚠ WARNING

Be sure to read and follow package label directions when using bellows adhesive.

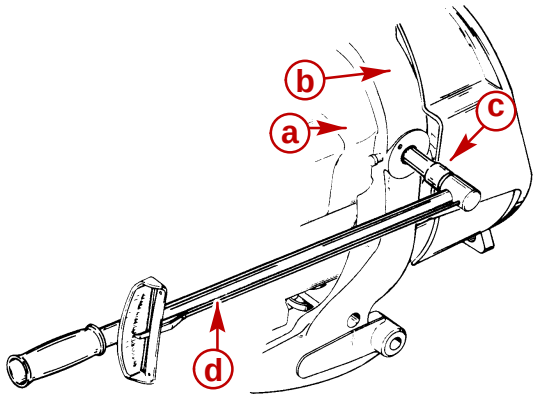
5. Install bell housing between gimbal ring. Push on bell housing and guide U-joint bellows onto gimbal housing mounting flange.



23363

a - Bell Housing
a - U-joint Bellows
b - Hose Clamp

6. Apply Locquic Primer “T” to internal bell housing threads and external hinge pin threads and allow to dry. Apply Loctite 271 to bell housing threads and install hinge pins. Torque hinge pins to 100 lb-ft (136 Nm).

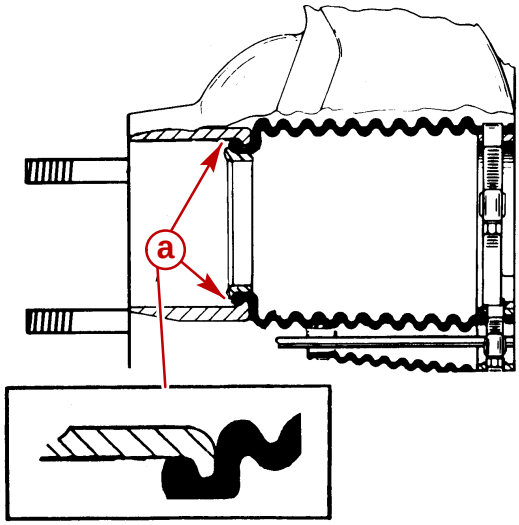


23292

a - Bell Housing
b - Gimbal Ring
c - Hinge Pin Tool (91-78310)
d - Torque Wrench

7. Install U-joint bellows on bell housing as follows:

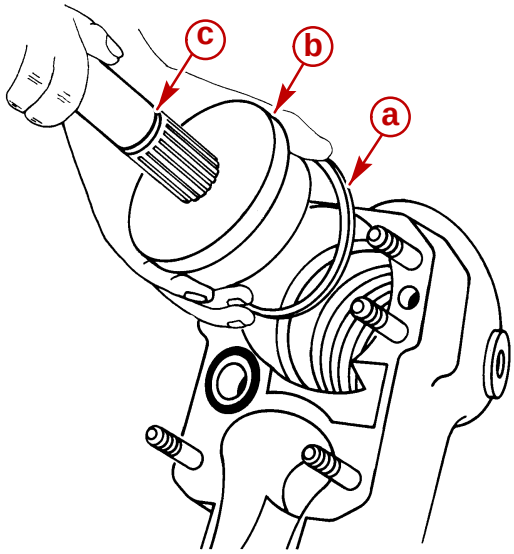
a. Position U-joint bellows on bell housing. Ensure that the bell housing flange rests in the groove at the end of bellows.



75268

a - Bell Housing Flange

b. Lubricate sleeve O.D. with engine cleaner (Quicksilver Power Tune works well and it evaporates quickly) and install sleeve with tool and suitable driving rod.



70207

a - Sleeve
b - Sleeve Installation Tool (91-818162)
c - Suitable Driving Rod

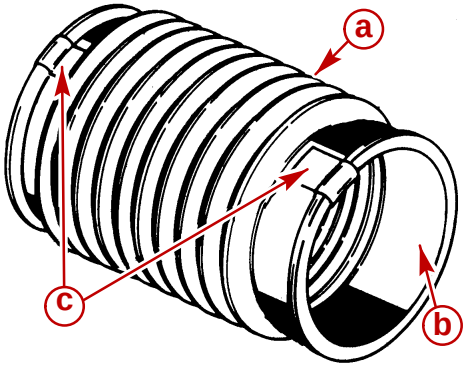
8. Install exhaust bellows on bell housing (one end was previously installed on gimbal housing) as follows:

   a. Clean bell housing mounting flange with sandpaper and wipe clean with lacquer thinner.

   b. Apply bellows adhesive to mounting surface on inside of bellows.

   c. Position grounding clip on bellows.

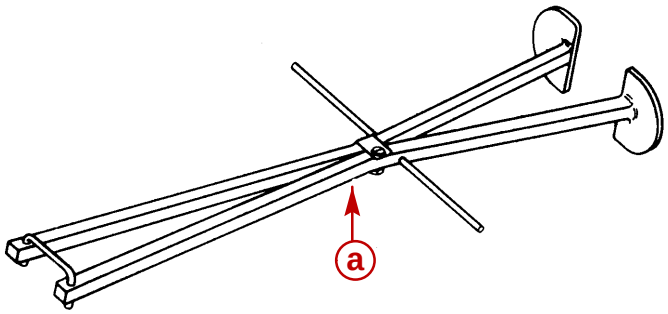
d. Place hose clamp over bellows end.



22079

a - Exhaust Bellows
b - Mounting Surface
c - Ground Clip

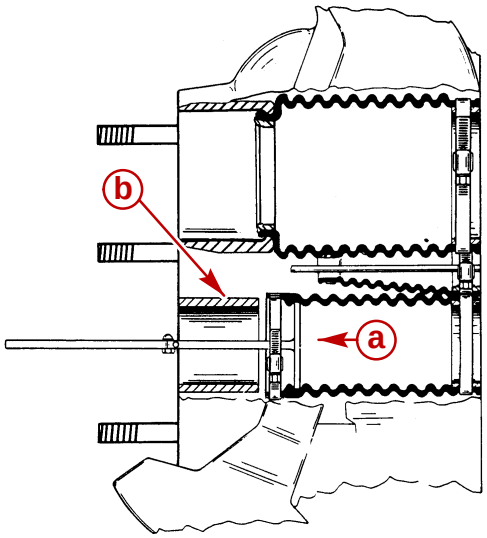
e. Place expander tool (91-45497A1) into first bellows convolution.



22161

a - Expander Tool

f. Pull tool until tool touches the mounting flange on bell housing (bellows starts to slip onto flange); then, release tool.



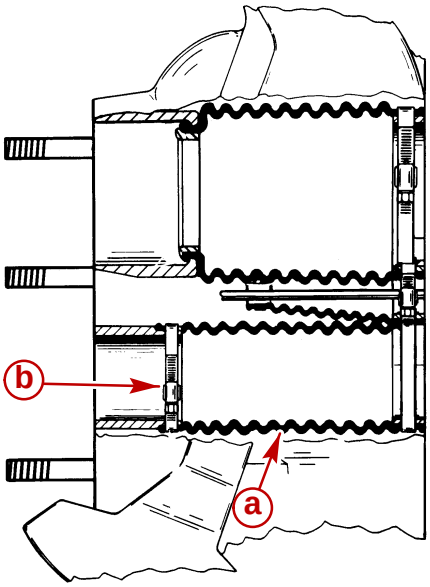
75270

a - Expander Tool (91-45497A1)
b - Bell Housing Flange

g. Reposition tool into the third bellows convolution.

h. Pull bellows onto bell housing flange.

i. Position hose clamp as shown and tighten securely. Remove tool.



75269

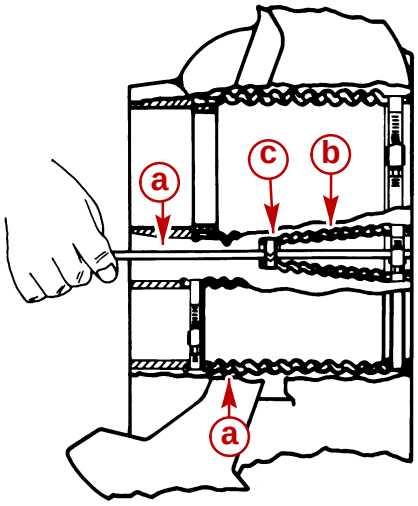
a - Exhaust Bellows
b - Hose Clamp

IMPORTANT: Ensure shift cable bellows crimp clamp is not flattened out when compressing in the following step. Crimp clamp must be compressed evenly around bellows and shift cable to prevent water leakage.

9. Insert shift cable through shift cable bellows.

NOTE: *After inserting shift cable through shift bellows be sure that bellows is in relaxed position [2 1/2 in (63 mm) from bell housing] before crimping clamp.*

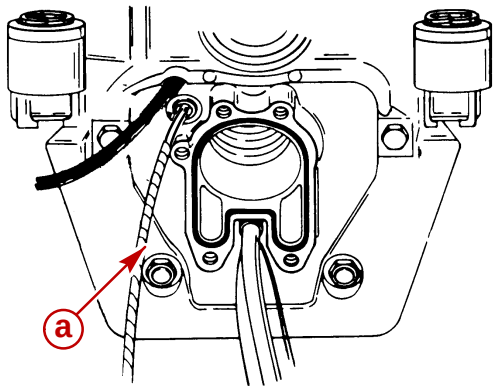
10. Compress crimp clamp.



70137

a - Shift Cable
b - Shift Cable Bellows
c - Crimp Clamp

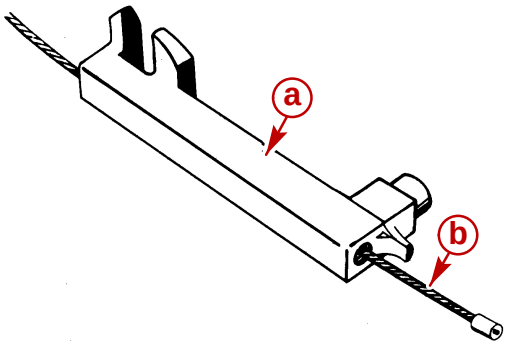
11. Install shift cable wrapping on shift cable from inner transom. Position approximately 2 inches from gimbal housing.



22030

a - Shift Cable Wrapping

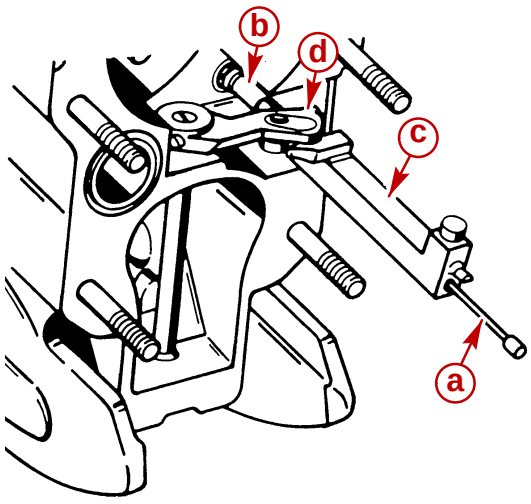
12. Install core wire through shift slide.



23262

a - Shift Slide
b - Core Wire

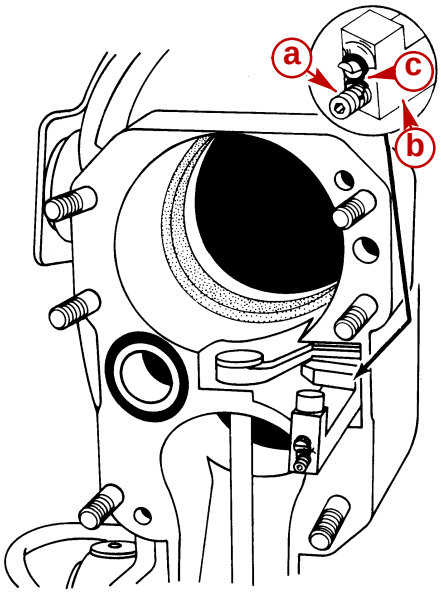
13. Install inner core wire through shift cable. Be sure and position shift lever roller between slot on shift slide.



23262

a - Inner Core Wire
b - Shift Cable
c - Shift Slide
d - Shift Lever

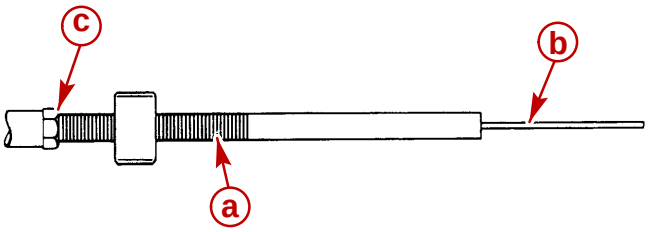
14. Install set screw into shift slide. Tighten until contact with core wire. Then back off 1/8 turn max. Safety wire set screw to shift slide using a “figure 8” pattern. Twist until tight and cut off excess length of safety wire. Bend tail of wire in-between screw and tab.



70139

a - Set Screw
b - Shift Slide
c - Safety Wire

15. Install threaded tube on shift cable and tighten until it bottoms out, **finger tight only**. Secure jam nut against shift cable end.

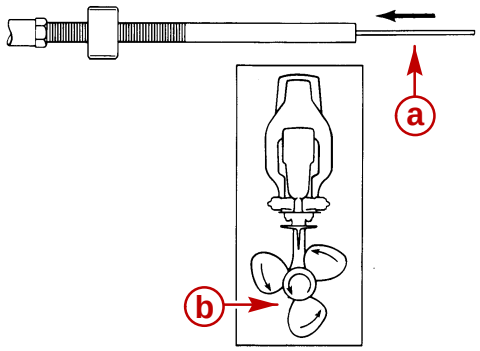


22183

a - Threaded Tube
b - Core Wire
c - Jam Nut

16. Install sterndrive unit.

17. Push in on drive unit shift cable core wire while simultaneously turning propeller shaft counterclockwise until shaft stops. To ensure that clutch is fully engaged maintain pressure on propeller shaft with a suitable device (elastic strap).



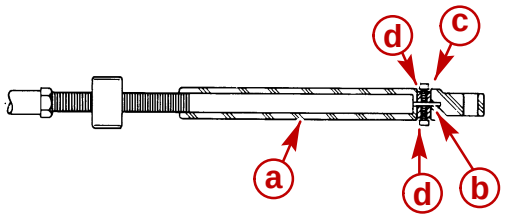
22183

23170

a - Inner Core Wire
b - Propeller Shaft

NOTE: *Clutch engagement will be in forward on standard rotation units and reverse for counter rotation.*

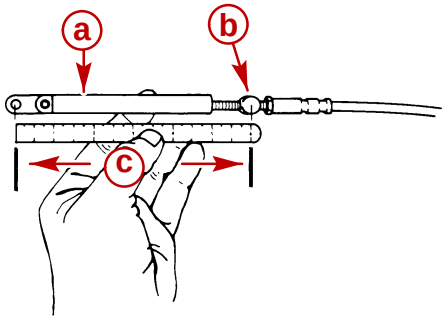
18. Install shift cable end guide over core wire and insert core wire through cable anchor. Tighten screws securely.



22183

a - Shift Cable End Guide
b - Core Wire
c - Cable Anchor
d - Screws (2)

19. While applying light pressure, measure distance between center of hole in shift cable end guide and center of brass barrel. Measurement should be 6 in. (153 mm).



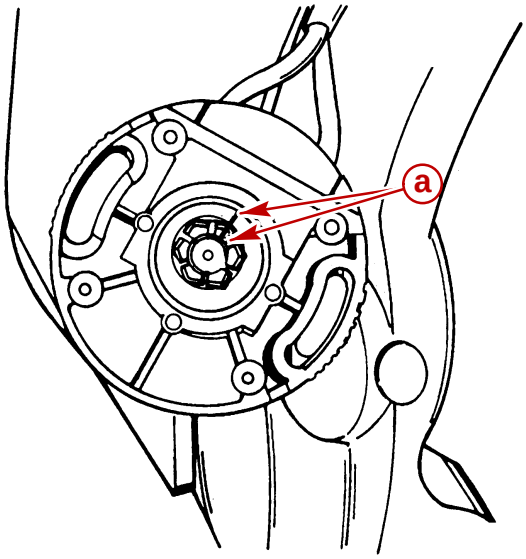
50484

a - End Guide
b - Brass Barrel
c - 6 in. (153 mm)

20. Connect shift cable to shift plate and adjust.

Trim Limit Switch Installation

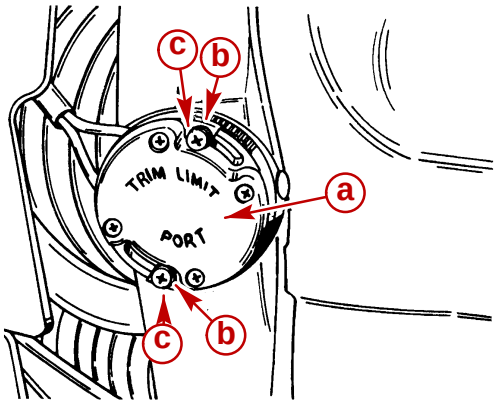
1. Align index marks on switch.



70860

a - Index Marks

2. Install trim limit switch.



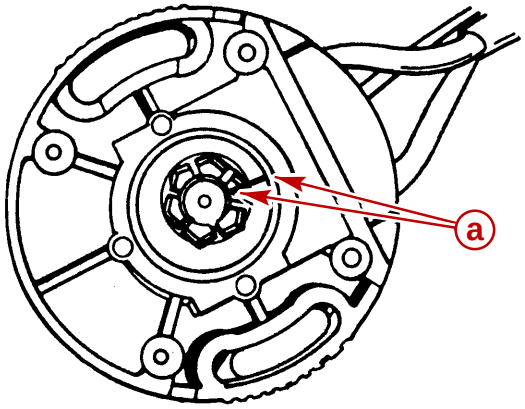
71221

a - Trim Limit Switch
b - Retainers (2)
c - Screws (2) And Washers (2)

3. Adjust trim limit switch. (See Section 4A)

Trim Position Sender Installation

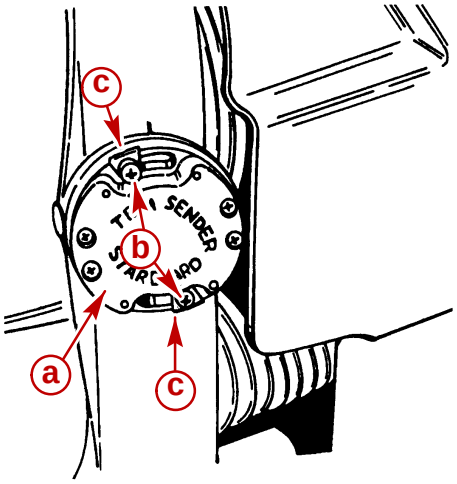
1. Align index marks.



70860

a - Index Marks

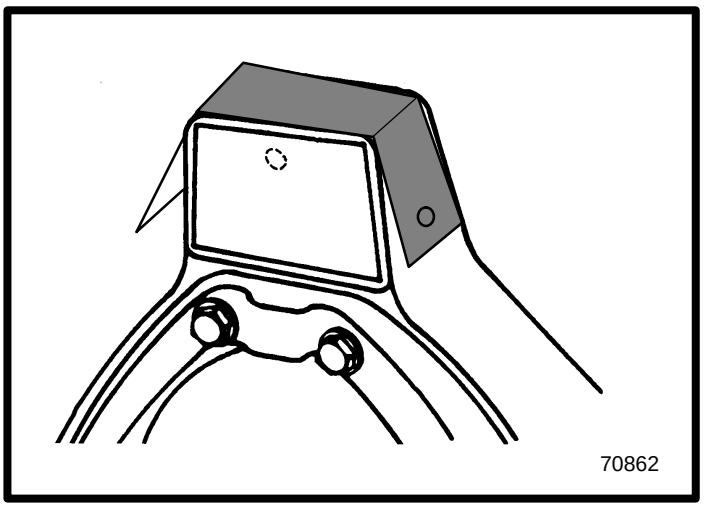
2. Install trim position sender.

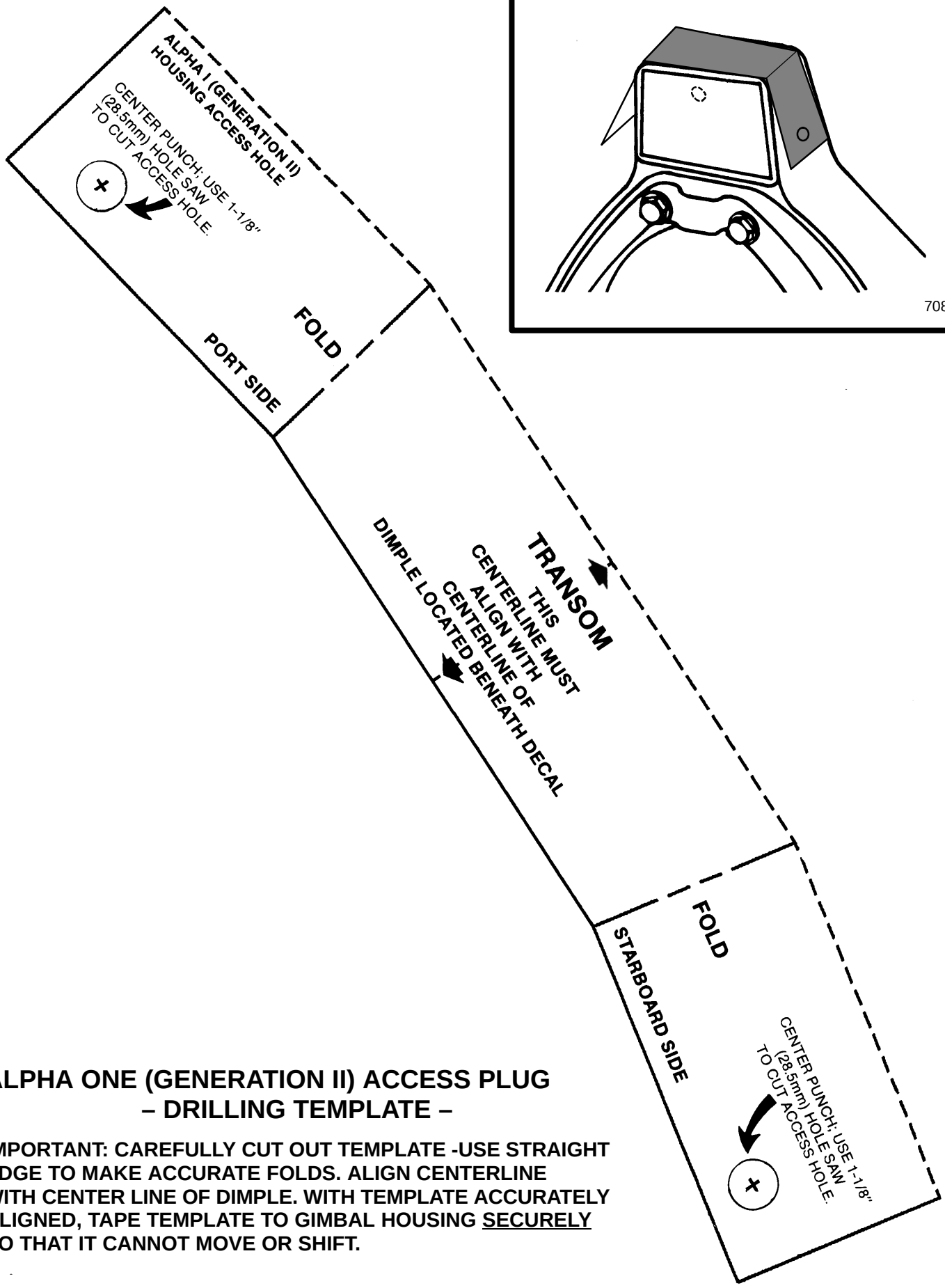


71220

a - Trim Position Sender
b - Screws (2) And Washers (2)
c - Retainers (2)

3. Adjust trim position sender. (See Section 4A)





ALPHA ONE (GENERATION II) ACCESS PLUG – DRILLING TEMPLATE –

IMPORTANT: CAREFULLY CUT OUT TEMPLATE -USE STRAIGHT EDGE TO MAKE ACCURATE FOLDS. ALIGN CENTERLINE WITH CENTER LINE OF DIMPLE. WITH TEMPLATE ACCURATELY ALIGNED, TAPE TEMPLATE TO GIMBAL HOUSING SECURELY SO THAT IT CANNOT MOVE OR SHIFT.

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POWER TRIM

Section 5A - Olidyne Trim Pump

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5 A

Trim Pump Specifications

Valve Pressure Specifications

Valve	Pressure	
	PSI	kPa
Up Circuit	2200-2600	15173-17932
Down Circuit	400-600	2759-4138

Electrical Specification

Pump Amperage Draw	Pressure @ Full Tilt UP	
	PSI	kPa
115 Amps at:	2200-2600	15173-17932

Torque Specification

Description	Torque		
	lb-in.	lb-ft	Nm
Up Pressure Relief Valve	70		7.9
Down Pressure Relief Valve	70		7.9
Thermal Relief Valve	70		7.9
Pump-to-Adaptor Mounting Screws	70		7.9
Motor-to-Adaptor Mounting Screws	25		2.8
Hex Plug Retainers		38-50	51-67
UP Pressure Hydraulic Hose (Black)	110		12
DOWN Pressure Hydraulic Hose (Gray)	110		12

Special Tools

Description	Part Number
Trim Pump Test Gauge Kit	91-52915A6
Torque Wrench (lb-in.)	91-66274
Jumper Wire (12 gauge)	Obtain Locally

Lubricants/Adhesives/Sealers

Description	Part Number
Quicksilver Power Trim and Steering Fluid	92-90100A1
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12
Liquid Neoprene	92-25711-3

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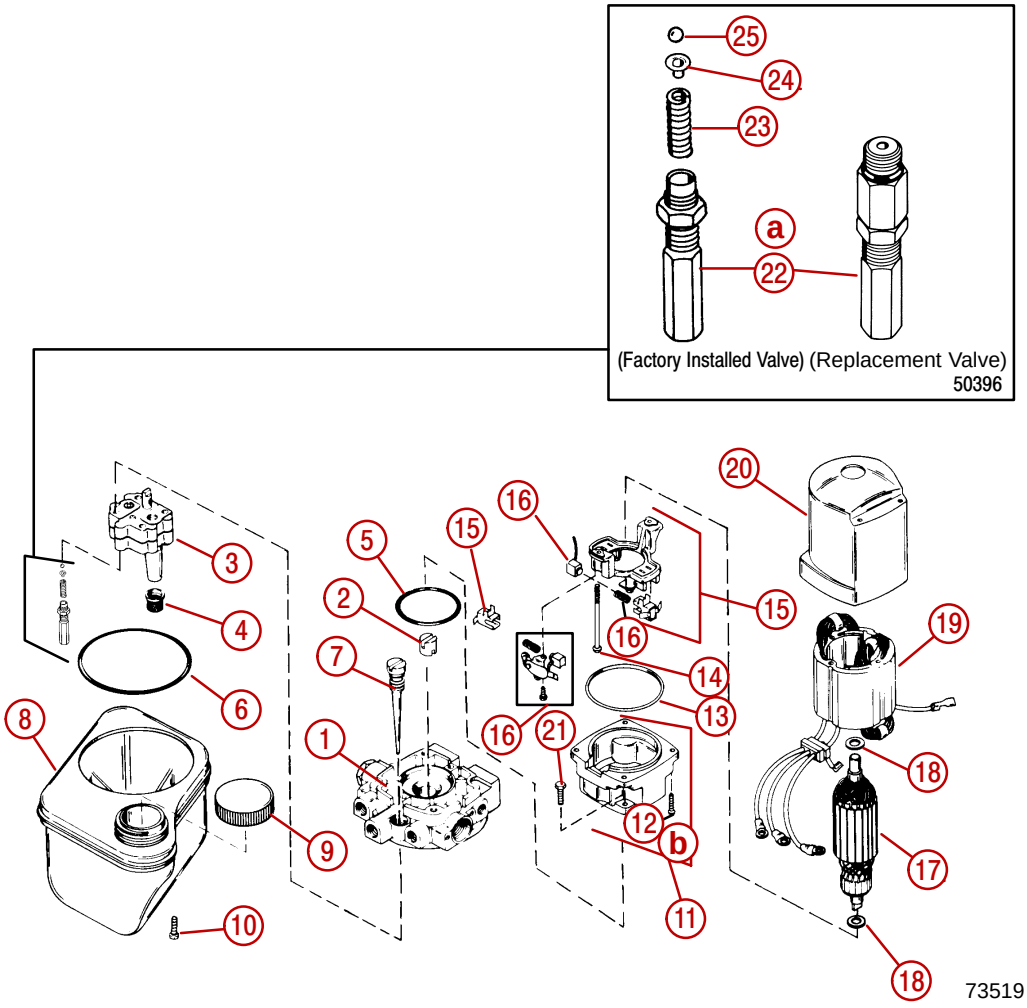
Trim Pump Exploded View

Oildyne Trim Pump



1 - Adaptor
2 - Coupling
3 - Pump
4 - Filter
5 - O-ring-Motor End
6 - O-ring, Reservoir End
7 - Dipstick
8 - Reservoir
9 - Cap (With Vent Hole)
10 - Screw (Includes O-ring)
11 - End Cap w/Bearing
12 - Screw
13 - O-ring
14 - Screw
15 - Brush Holder Kit
16 - Brush set
17 - Armature
18 - Thrust Washer
19 - Field and Frame
20 - Housing
21 - Screw
22 - Relief Valve With:
23 - Spring
24 - Eyelet
25 - Check Ball

Replacement Relief Valve Color Code:

Down Pressure: Green

Up Pressure: Blue

Thermal: Gold

Torque Specifications

a - 75 lb-in. (8 Nm)
b - 25 lb-in. (2.8 Nm)

Maintaining Power Trim Pump Oil Level

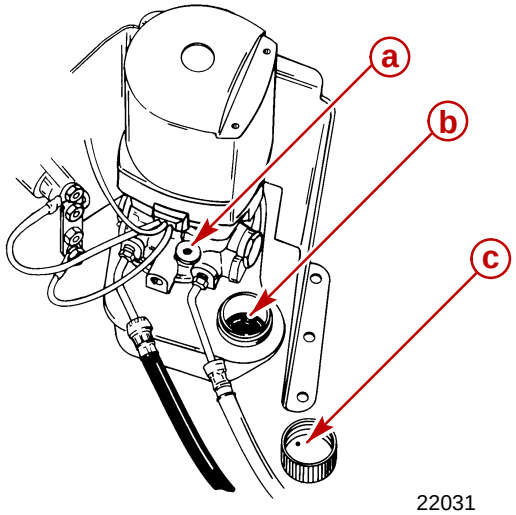
⚠ CAUTION

Avoid pump damage. Vent reservoir pressure by backing out the vent screw two turns after tightening completely. Units without a vent screw have a vented fill cap. Remove the fill neck seal on models without a vent screw.

IMPORTANT: Check the oil level with the stern drive unit in the full down position.

IMPORTANT: If quicksilver Power Trim and steering fluid is not available, SAE 10W-30 or 10W-40 engine oil can be used in the system.

1. Remove the fill cap, then raise and lower the drive unit 3 to 5 times to purge air from the system. Let air settle for several minutes and then purge air again. Check the oil level visually.
2. If there is a vent screw, it must be backed out 2 full turns. If there is no vent screw, remove the fill neck seal to vent the pump.
3. Maintain the oil level between the “Max” and “Min” marks on the side of the reservoir. Fill to the bottom lip on the fill neck.



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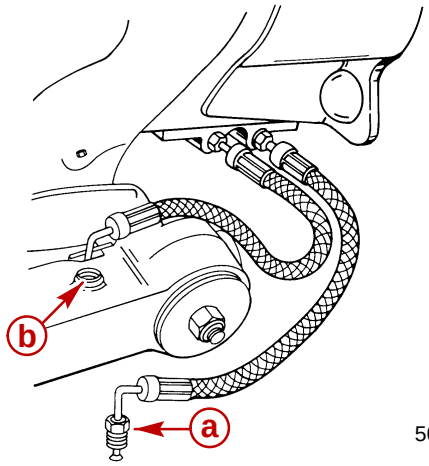
a - Vent Screw
b - Bottom Lip on the Fill Neck
c - Vent Hole

Air Bleeding Power Trim System

1. The Power Trim System will purge itself of a small amount of air by raising and lowering the drive unit several times. However, if a rebuilt trim cylinder is being installed (which has not been filled with oil), the following bleeding procedure should be used to remove the air from the system.

Bleeding OUT/UP Trim Circuit

1. Fill the pump reservoir to the proper level as explained preceding. (The trim cylinder must be compressed.)
2. Disconnect the OUT/UP hose from the front connection on the trim cylinder. If both cylinders were rebuilt, disconnect the hoses from both cylinders.
3. Direct the end of the trim hoses(s) into a container.
4. Run the trim pump in the UP direction until a solid, air-free stream of fluid is expelled from the hose(s). Reconnect the hose(s) and tighten securely.
5. Refill the trim pump to the proper level.



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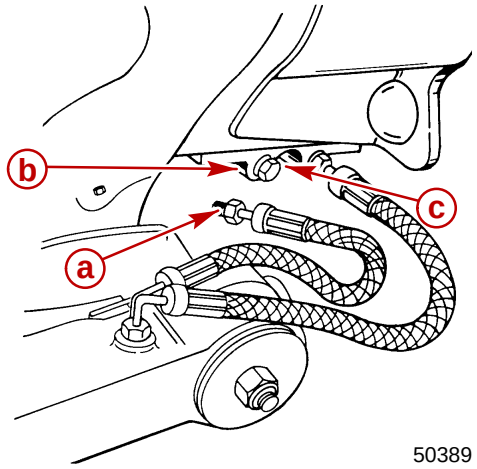
a - OUT/UP Trim Hose
b - Front Connection On Trim Cylinder

Bleeding IN/DOWN Trim Circuit

1. Ensure that the pump reservoir is filled to the proper level.
2. Disconnect the IN/DOWN hose from the rear connection on the gimbal housing hydraulic connector. If both cylinders were rebuilt, disconnect the hoses from both sides of the hydraulic connector.
3. Plug the holes in the hydraulic connector, using a plug (22-38609) or suitable device.
4. Direct the end of the trim hose(s) into a container.
5. Run the trim pump in the Up direction until the trim cylinders are fully extended.
6. Remove the plug(s) from the gimbal housing hydraulic connector and momentarily run the trim pump in the IN/DOWN direction until a solid, air-free stream of fluid is expelled from the rear hole(s) in the hydraulic connector. Reconnect the trim hose(s) and tighten securely.
7. Lower the drive unit to the full IN/DOWN position and refill the trim pump to the proper level. Run the trim system IN/DOWN and OUT/UP several times and recheck the fluid level.



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a - In/Down Trim Hose
b - Hydraulic Connector
c - Plug (22-38609)

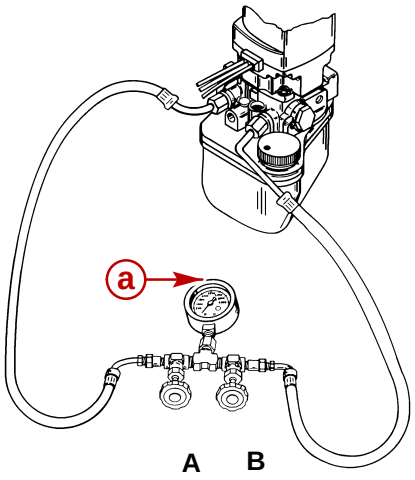
Testing Power Trim Pump

⚠ CAUTION

Cross connecting trim hoses will damage the stern drive housing. Appropriately mark trim hoses and hose connections to ensure proper reassembly.

Test Gauge

1. Check the trim pump oil level. Fill if necessary.
2. Place the drive unit in the full IN/DOWN position.
3. Connect the test gauge at the most convenient location (at pump or hydraulic connector).



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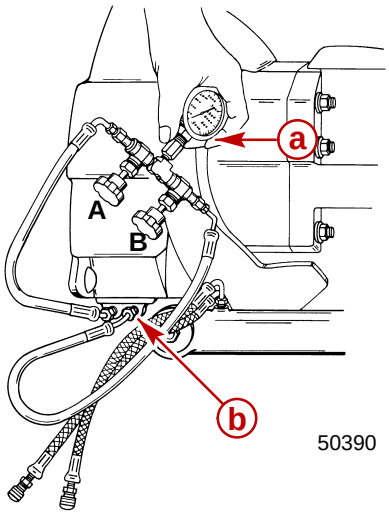
Gauge Connected to Pump

a - Hydraulic Test Gauge (91-52915A6)



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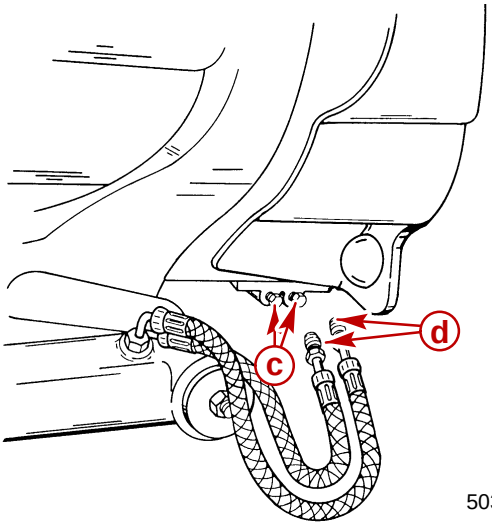

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Gauge Connected to Hydraulic Connector

a - Hydraulic Test Gauge (91-52915A6)
b - Gimbal Housing Hydraulic Connector
c - Caps (Supplied with Gauge)
d - Plugs (Supplied with Gauge)

4. Open valve “A” and “B” and operate the pump UP and DOWN for several seconds to purge air.

Internal Restriction Test

1. Open valves “A” and “B”.
2. Operate pump OUT/UP and IN/DOWN while observing gauge.
3. Replace adapter if pressure is in excess of 200 psi (1379 kPa).

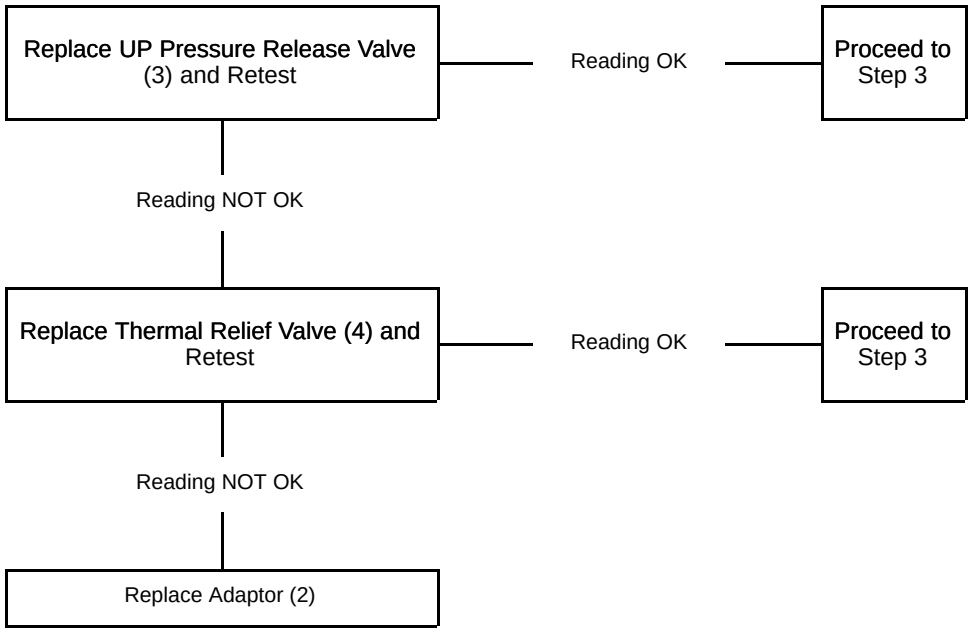
OUT/UP Pressure Test

NOTE: *The numbers in parenthesis, e.g. (3), refer to the trim pump hydraulic system diagram on page 5A-11.*

1. Leave valve “A” open and close valve “B.”
2. Run pump OUT/UP while observing the gauge. The reading should be 2200-2600 psi. (15173-17932 kPa).

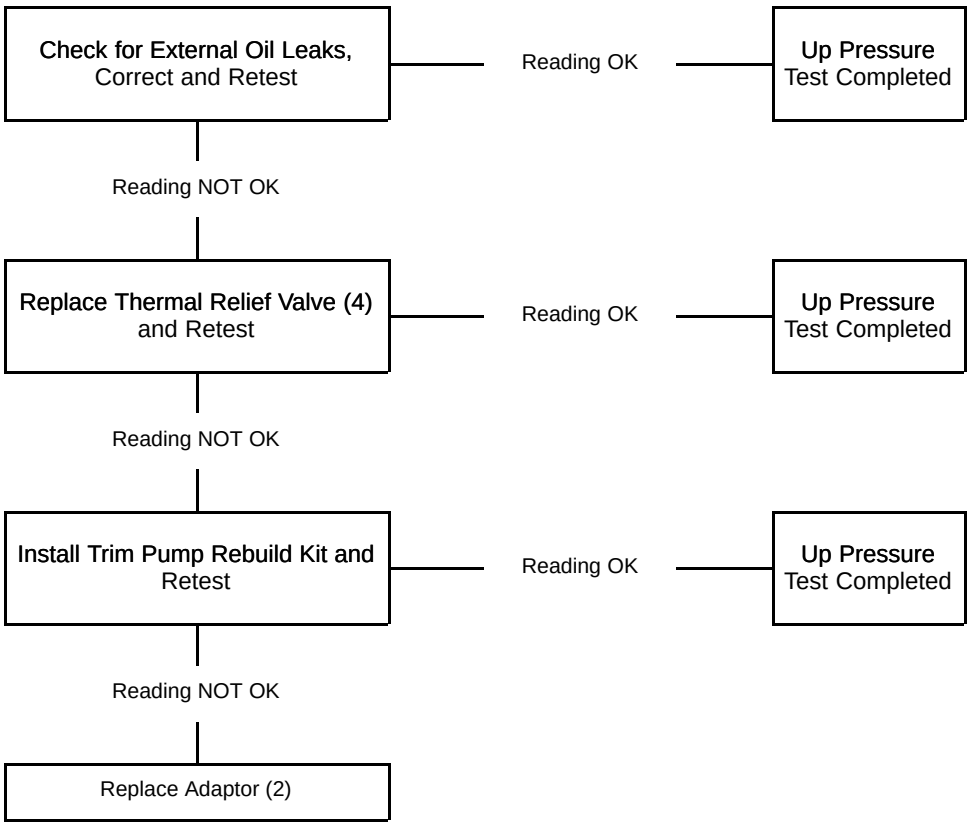
If Gauge reading is within specifications, proceed to step 3.

If Gauge reading is not within specifications, perform the following:


Replace UP Pressure Release Valve (3) and Retest
Reading OK
Proceed to Step 3
Reading NOT OK
Replace Thermal Relief Valve (4) and Retest
Reading OK
Proceed to Step 3
Reading NOT OK
Replace Adaptor (2)

3. Run the pump OUT/UP until the gauge reading reaches 2200-2600 psi (15173-17932 kPa). Stop pumping OUT/UP The pressure should not fall below 1900 psi (13104 kPa). If Gauge reading is 1900 psi (13104 kPa) or above, UP pressure test completed. If Gauge reading is below 1900 psi (13104 kPa) perform the following:

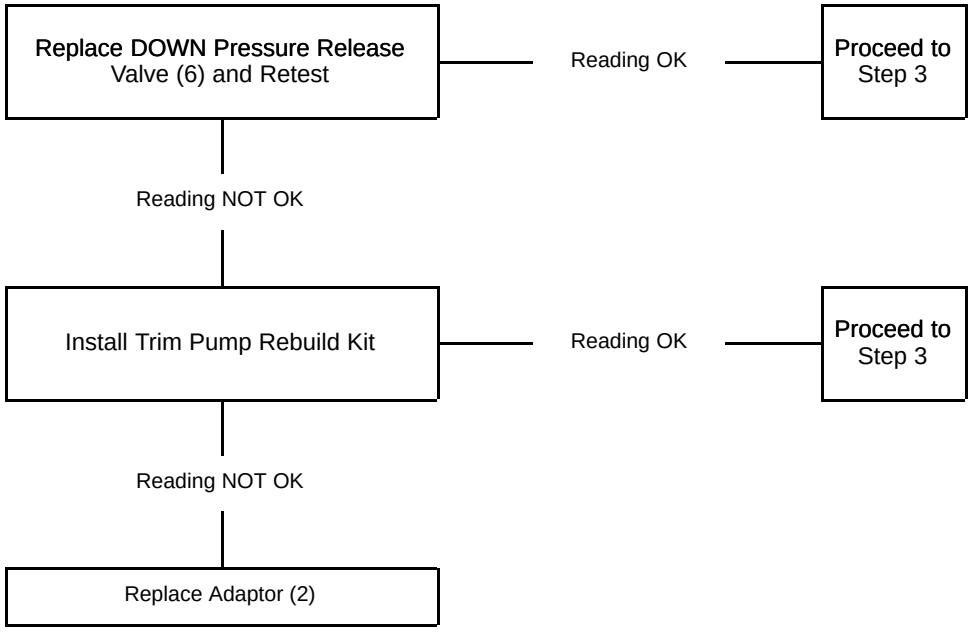
NOTE: *A small leak will cause a pressure drop to be seen.*


Check for External Oil Leaks, Correct and Retest
Reading OK
Up Pressure Test Completed
Reading NOT OK
Replace Thermal Relief Valve (4) and Retest
Reading OK
Up Pressure Test Completed
Reading NOT OK
Install Trim Pump Rebuild Kit and Retest
Reading OK
Up Pressure Test Completed
Reading NOT OK
Replace Adaptor (2)

IN/DOWN Pressure Test

NOTE: *The numbers in parenthesis, e.g. (3), refer to the trim pump hydraulic system diagram.*

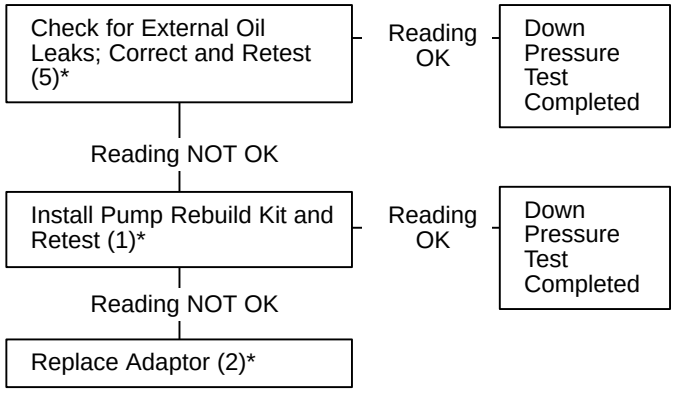
1. Close valve “A” and open valve “B.”
2. Run the pump IN/DOWN while observing the gauge. The reading should be 400-600 psi (2759-4138 kPa). If Gauge reading is within specifications, proceed to step 3. Gauge reading is NOT within specifications, perform the following.



3. Run pump IN/DOWN until gauge reading reaches 400 - 600 psi (2759 - 4138 kPa). Stop pumping IN/DOWN. Pressure should not fall below 350 psi (2414 kPa).

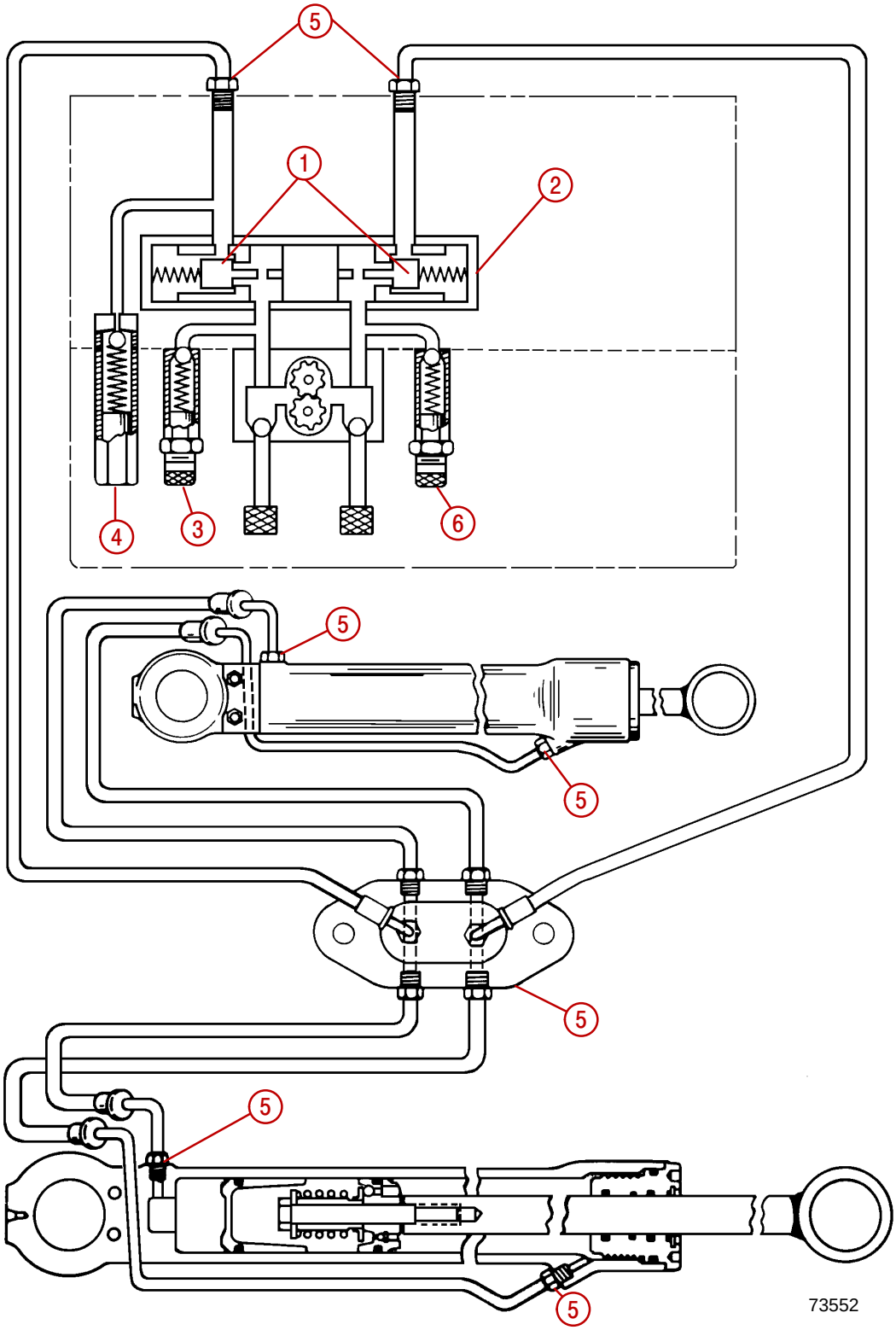
NOTE: *A small leak will cause a pressure drop to be seen.*

- Gauge reading above 350 psi (2414 kPa), DOWN Pressure Test completed.
- Gauge reading below 350 psi (2414 kPa), perform the following:


Check for External Oil Leaks; Correct and Retest (5)*
Reading OK
Down Pressure Test Completed
Reading NOT OK
Install Pump Rebuild Kit and Retest (1)*
Reading OK
Down Pressure Test Completed
Reading NOT OK
Replace Adaptor (2)*

* The callout numbers refer to the Trim Pump Hydraulic System drawing on p. 5A-8.

Trim Pump Hydraulic System

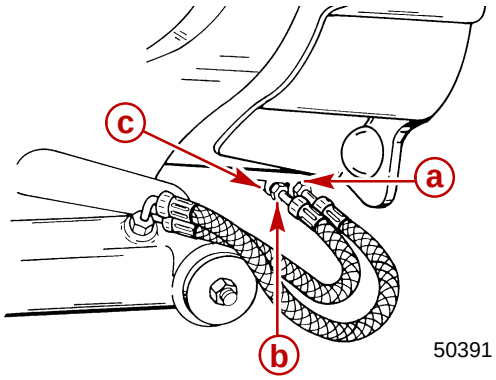


1 - Shuttle
2 - Pump Adaptor
3 - OUTUP/ Pressure Relief Valve
4 - Thermal Relief Valve
5 - Fitting
6 - IN/DOWN Pressure Relief Valve

Trim Cylinder Internal Leak Test

IMPORTANT: Before performing the following test, ensure that OUT/UP pressure meets specifications designated in OUT/UP pressure test.

1. Reconnect the trim cylinder hoses (if removed in a previous test) as follows:
   a. Remove the plugs and caps.
   b. Install the UP hose to the forward hole on the hydraulic connector. Tighten securely.
   c. Install the DOWN hose to the aft hole on the hydraulic connector. Tighten securely.



a - UP Hose
b - DOWN Hose
c - Hydraulic Connector

2. Connect the gauge at the most convenient location, at the pump orat the hydraulic connector.

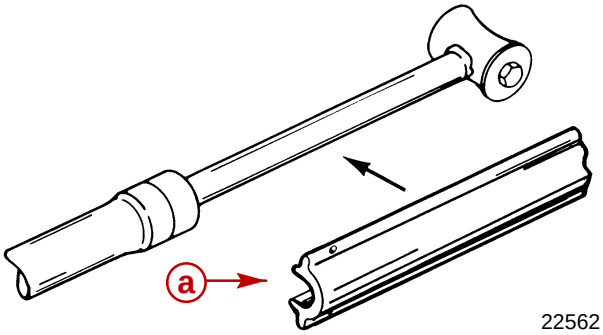
3. Open valves “A” and “B” and the run pump OUT/UP and IN/DOWN several times (to purge air).
4. Run the pump OUT/UP until the trim cylinders are fully extended; then, observe the gauge while pumping. The pressure should be 2200-2600 psi (15173-17932 kPa).
5. Stop pumping OUT/UP Pressure should not fall below 1900 psi (13104 kPa).
   a. **Reading below 1900 psi (13105 kPa)** indicates a trim cylinder leak. Use the following steps to locate the faulty cylinder.
   b. If the gauge is connected at the pump, reconnect the gauge at the gimbal housing hydraulic connector. Repeat step 2: then run the pump in the OUT/UP direction until the trim cylinder is fully extended.
   c. Close the valve on the test gauge an repeat Steps 3 and 4.

- **If Reading is now within specification:** The trim cylinder on the same side that test gauge is connected to is faulty.
- **If Reading is still not within specification:** The trim cylinder on the opposite side from where the test gauge is connected is faulty.

Trim Cylinder Shock Piston Test

If all previous trim system test results meet specifications, but drive unit will not trim IN/DOWN, the problem may be a leaky trim cylinder shock piston. Use the following test to check for this condition. No test gauge required.

1. Run the pump in the OUT/UP direction until the trim cylinders are fully extended.
2. Use a suitable devise to keep trim cylinder piston rods from retracting. The Quicksilver Trailering Kit works well for this purpose.



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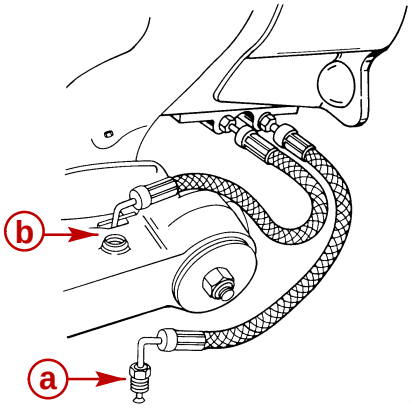
a - Trailering Clip

3. Disconnect the UP trim hose from a trim cylinder.



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a - UP Trim Hose
b - Front Connection

4. Run the pump in the IN/DOWN direction. If oil flows from the UP port on the trim cylinder, the shock piston is leaking and must be replaced.

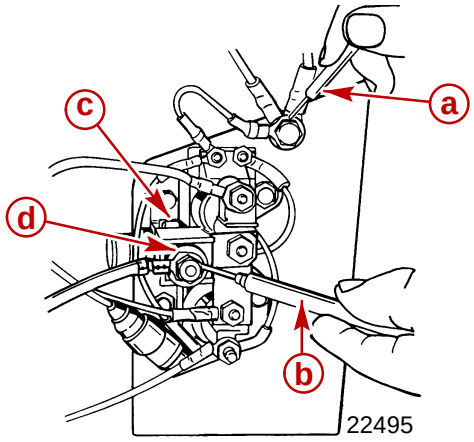
Motor and Electrical Bench Tests

110 Amp Fuse Test (Pump in Boat)

⚠ WARNING

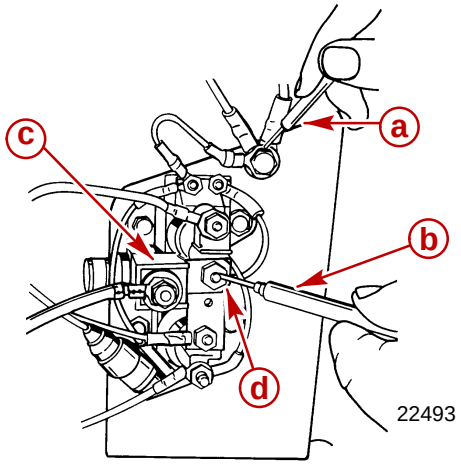
DO NOT perform this test near flammables (or explosives) as a spark may occur when making connections.

1. Check for voltage at terminal “d” using a volt meter. Voltage MUST BE indicated before proceeding with the next check.



a - Volt Meter Negative (-) Lead
b - Volt Meter Positive (+) Lead
c - Fuse (RED in Color)
d - Check for Voltage Here

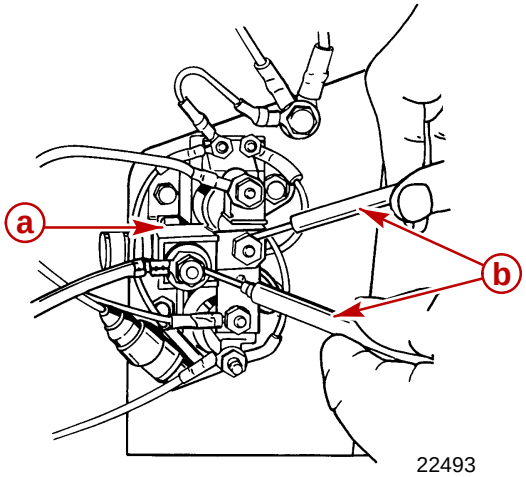
2. Check for voltage at terminal “d” using a volt meter.
   a. **Voltage Indicated:** Fuse O.K.
   b. **Voltage Not Indicated:** Replace the fuse.



a - Volt Meter Negative (-) Lead
b - Volt Meter Positive (+) Lead
c - Fuse (RED in Color)
d - Check for Voltage Here

110 Amp Fuse Test (Pump Out of Boat)

1. Connect the ohmmeter leads between the terminals on the fuse.

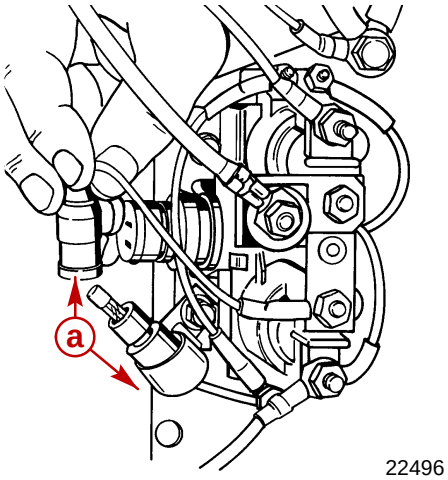


a - 110 Amp Fuse (Red)
b - Ohmmeter Leads

Zero Ohms Reading (Full Continuity)-Fuse OK.
High Ohms Reading (No Continuity)-Replace fuse.

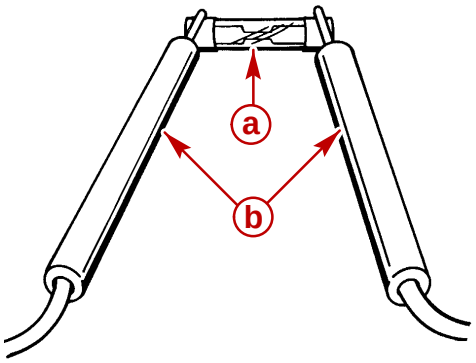
20 Amp Fuse Test

1. Remove the fuse from the fuse holder.



a - Fuse Holder

2. Connect one ohmmeter lead to each end of the fuse.



a - 20 Amp Fuse
b - Ohmmeter Leads

Zero Ohms Reading (Full Continuity)-Fuse OK.
High Ohms Reading (No Continuity)-Replace fuse.

Trim Pump Motor Test (In Boat)

⚠ WARNING

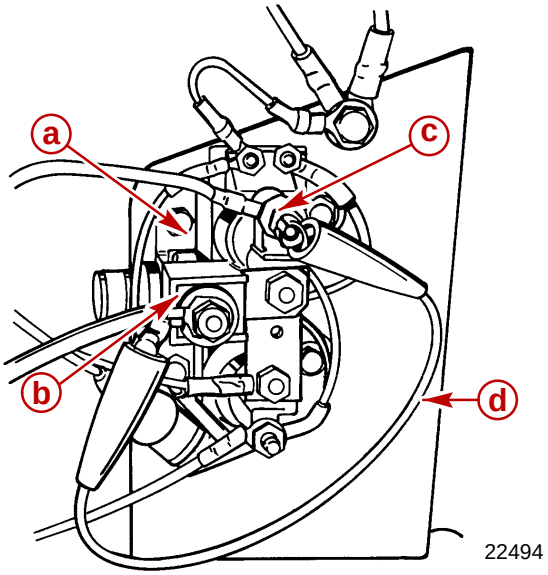
Making electrical connections may cause a spark. DO NOT perform this test near flammables (or explosives).

⚠ WARNING

Remain clear of the drive unit when performing power trim pump motor tests with pump in the boat and hydraulic hoses connected.

1. OUT/UP Operation.
   a. Connect a 12 gauge jumper wire between the positive (+) solenoid terminal and the blue-white motor lead terminal.

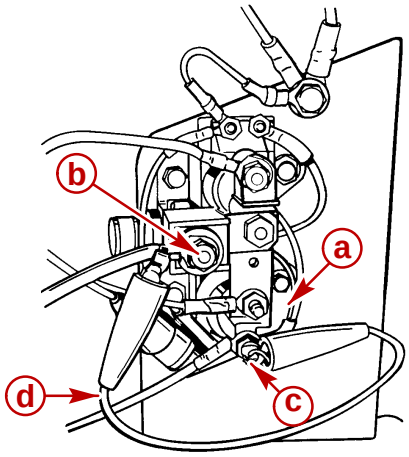
b. The motor should run.



IN/DOWN Position

a - OUT/UP Solenoid
b - Positive Terminal (+)
c - BLUE-WHITE Motor Lead Terminal
d - Jumper Wire

2. IN/DOWN Operation.
   a. Connect a 12 gauge jumper wire between the positive (+) solenoid terminal and the green-white motor lead terminal.
   b. The motor should run.



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a - IN/DOWN Solenoid
b - Positive Terminal (+)
c - GREEN-WHITE Motor Lead Terminal
d - Jumper Wire

3. If the motor does not run, refer to “Motor Repair.”

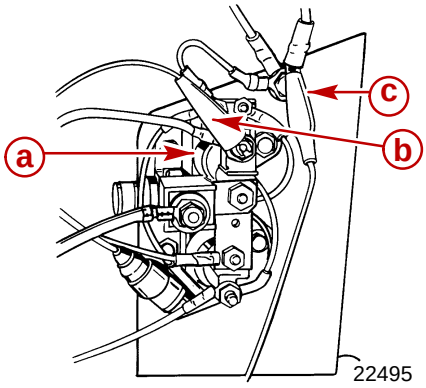
Trim Pump Motor Test (Out of Boat)

⚠ WARNING

Making electrical connections may cause a spark. DO NOT perform this test near flammables or explosives.

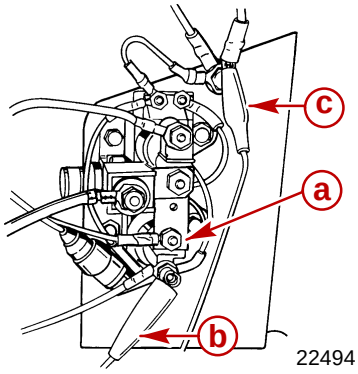
1. Remove the trim pump from the boat. Refer to “Trim Pump Removal”.
2. Remove the fluid from the trim pump reservoir.
3. OUT/UP Operation
   a. Connect a 12 volt Positive (+) supply lead to the blue-white motor lead terminal.
   b. Connect the negative (–) supply lead to a good ground on the pump.

c. The motor should run.



a - OUT/UP Solenoid
b - 12 Volt Positive (+) Supply Lead
c - Negative Supply Lead

4. IN/DOWN Position.
   a. Connect a 12 volt Positive (+) supply lead to the green-white motor lead terminal.
   b. Connect the negative (–) supply lead to a good ground on the pump.
   c. The motor should run.



a - IN/DOWN Solenoid
b - 12 Volt Positive Supply (+) Lead
c - Negative Supply Lead

5. If the motor does not run, refer to “Motor Repair.”

Solenoid Test (Pump In Boat)

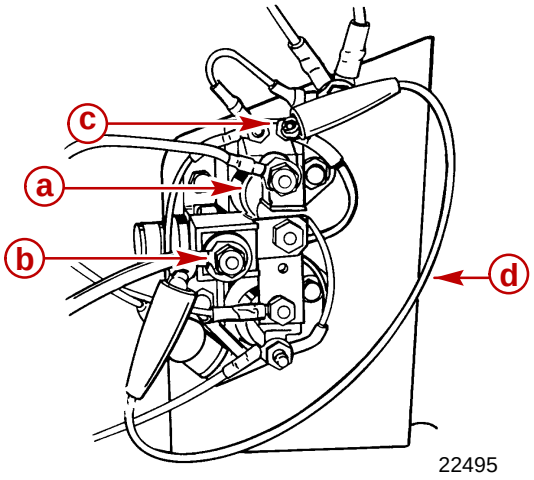
⚠ WARNING

DO NOT perform this test near flammables (or explosives) as a spark may occur when making connections.

⚠ CAUTION

Remain clear of the drive unit when performing power trim pump motor tests with pump in the boat and hydraulic hoses connected.

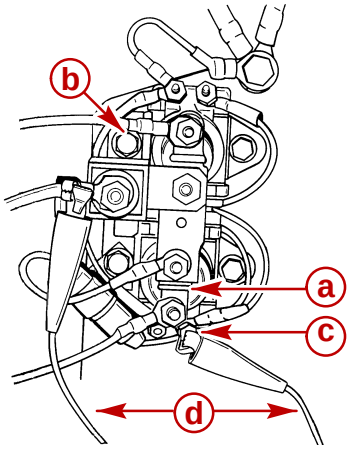
1. UP/OUT Solenoid.
   a. Connect a 12 gauge jumper wire between the positive (+) solenoid terminal and the blue-white harness wire terminal.
   b. The motor should run.



a - OUT/UP Solenoid
b - Positive (+) Solenoid Terminal
c - BLUE-WHITE Harness Wire Terminal
d - Jumper Wire

2. IN/DOWN Solenoid.
   a. Connect a 12 gauge jumper between the positive (+) solenoid terminal and the green-white harness wire terminal.

b. The motor should run.



22494

a - IN/DOWN Solenoid
b - Positive (+) Solenoid Terminal
c - GREEN-WHITE Harness Wire Terminal
d - Jumper Wire

3. If the pump motor does not run in one direction or another, replace the appropriate solenoid.

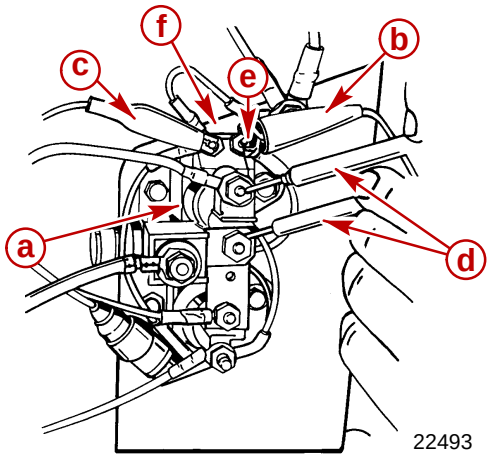
See the wiring diagram.

Solenoid Test (Pump Out of Boat)

⚠ WARNING

DO NOT perform this test near flammables (or explosives) as a spark may occur when making connections.

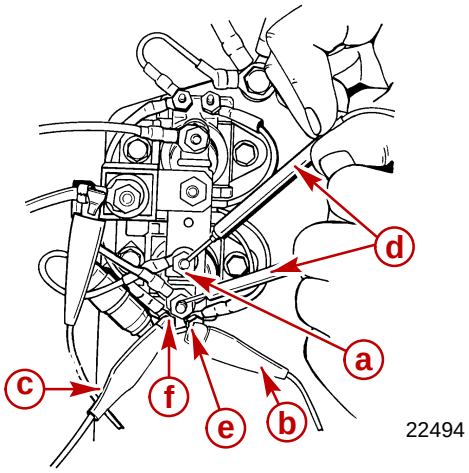
1. Remove the trim pump from the boat. Refer to “Trim Pump Removal”.
2. Remove the fluid from the trim pump reservoir.
3. OUT/UP Solenoid.
   a. Connect a 12 volt Positive (+) supply lead to blue-white harness terminal wire.
   b. Connect the negative (–) supply lead to the solenoid ground terminal as shown.
   c. Connect the ohmmeter leads to the large terminals on the solenoid.



a - OUT/UP Solenoid
b - 12 volt Positive (+) Supply Lead
c - Negative (–) Supply Lead
d - Ohmmeter Leads
e - BLUE-WHITE Harness Wire Terminal
f - Solenoid Ground Terminal

4. **Zero Ohms Reading** (Full Continuity)-Solenoid is OK.
   High Ohms Reading (No Continuity)-Replace solenoid.
5. IN/DOWN Solenoid.
   a. Connect a 12 volt positive (+) supply lead to the green-white harness wire terminal.
   b. Connect the negative (–) supply lead to the solenoid ground terminal.

c. Connect the ohmmeter leads to the large terminals on the solenoid.



a - IN/DOWN Solenoid
b - 12 Volt Positive (+) Supply Lead
c - Negative (–) Supply Lead
d - Ohmmeter Leads
e - GREEN-WHITE Harness Wire Terminal
f - Solenoid Ground Terminal

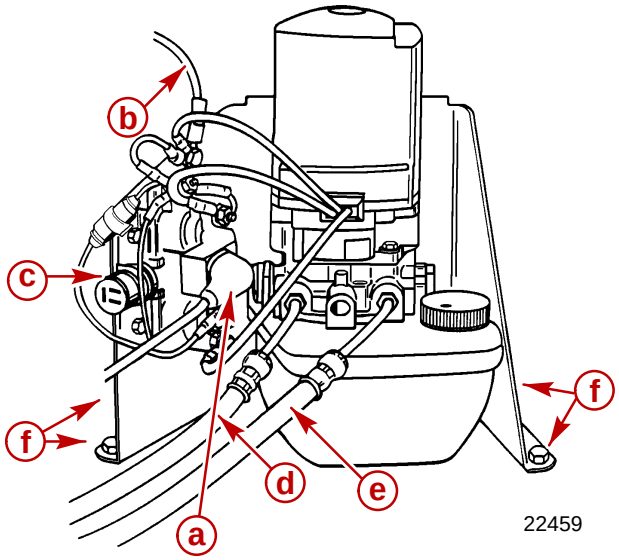
6. **Zero Ohms Reading** (Full Continuity)-Solenoid is OK.
   High Ohms Reading (No Continuity)-Replace solenoid.

See the wiring diagram.

Trim Pump Removal

1. Disconnect the trim pump battery leads from the battery. Disconnect the negative lead first.
2. Disconnect the trim harness connector (3 pronged connector) from the trim pump.
3. Remove the hydraulic hoses from the trim pump. Cap the hose ends.

4. Remove the lag bolts and washers. Then, lift the pump and floor bracket from the boat.

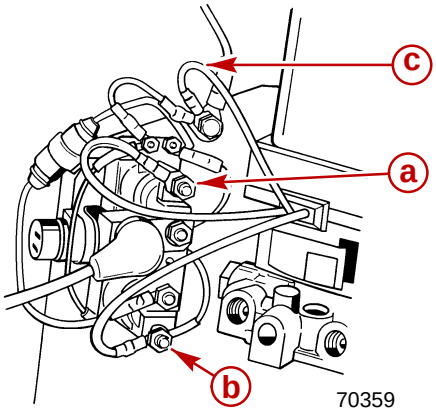


a - Positive Battery Lead
b - Negative Battery Lead
c - Harness Connector
d - BLACK Hydraulic Hose (UP Hose)
e - GRAY Hydraulic Hose (DOWN Hose)
f - Lag Bolts and Washers

Hydraulic Repair

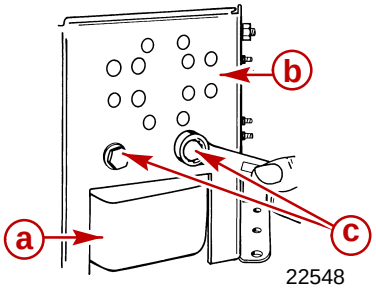
Disassembly

1. Disconnect the trim motor wires.



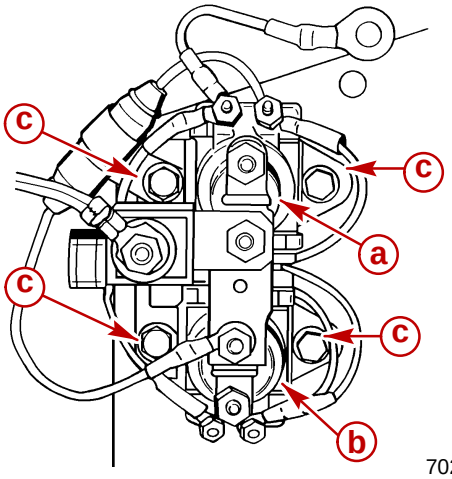
a - BLUE/WHITE Motor Wire
b - GREEN/WHITE Motor Wire
c - BLACK Ground Wire

2. Remove the mounting bolts and trim pump from the floor bracket.



a - Trim Pump
b - Floor Bracket
c - Mounting Bolts

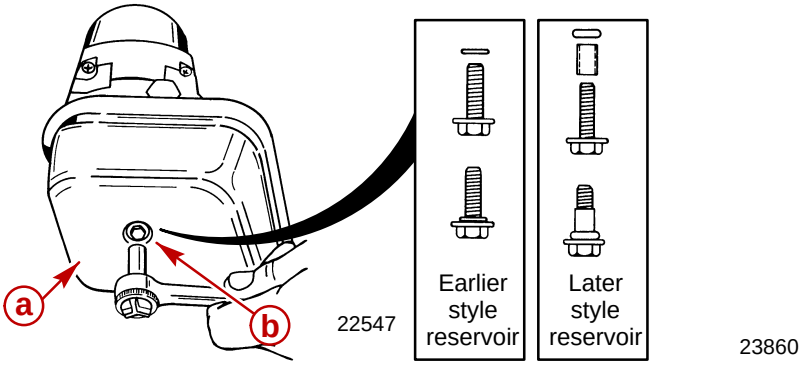
3. Remove the solenoids if replacement is necessary.



70232

a - UP Solenoid
b - DOWN Solenoid
c - Mounting Bolts (2 on Each Solenoid)

4. Remove the pump reservoir.

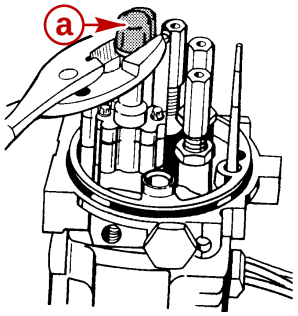


22547 23860

a - Pump Reservoir
b - Bolt and O-ring - Spacer

Filter Replacement

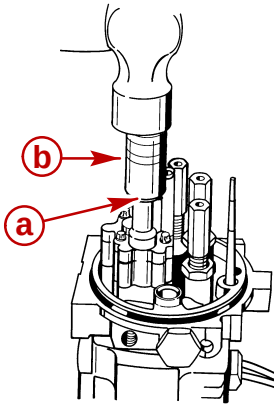
1. Remove the filter by twisting while pulling upward.



70932

a - Filter

2. Install a new filter.



22547

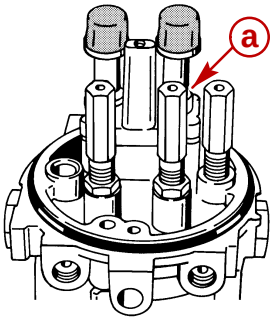
a - Filter
b - 5/8 in. Socket

UP Pressure Relief Valve Replacement

NOTE: *The UP pressure relief valve in the kit is color coded blue for easy identification.*

IMPORTANT: A difference exists between the factory installed and the replacement pressure relief valves. Once the jam nut is loosened on a factory installed relief valve, the valve is out of adjustment.

IMPORTANT: When installing a replacement pressure relief valve, DO NOT loosen or attempt to remove the hex "jam" nut. This valve is preset at the factory for proper UP pressure relief.

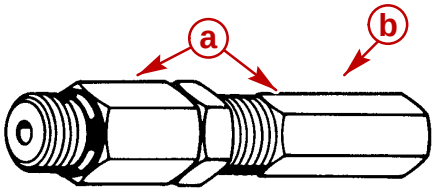


70872

a - Factory Installed UP Pressure Relief Valve

NOTE: *Original factory installed pressure relief valves will be a natural steel finish - they will NOT be color coded.*

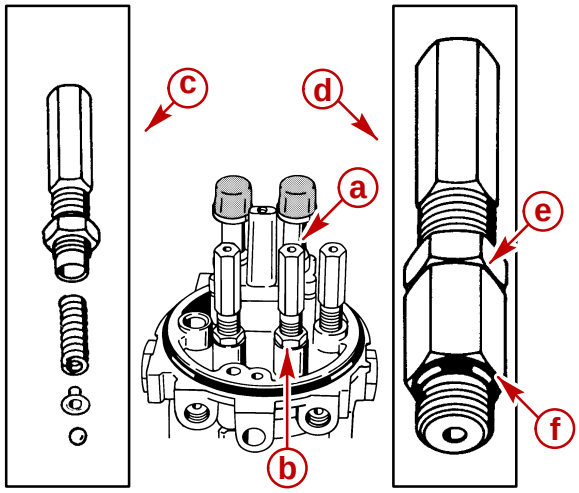
1. Replace the UP pressure relief valve. Ensure that the threaded hole is free of dirt. Lubricate the O-ring at the base of the new valve with Power Trim and Steering Fluid and install. Torque to 70 lb-in. (7.9 Nm).



50396

Current Replacement Pressure Relief Valve

a - Replacement UP Pressure Relief Valve
b - Color Coded Blue Area



Original Factory Installed Pressure Relief Valve

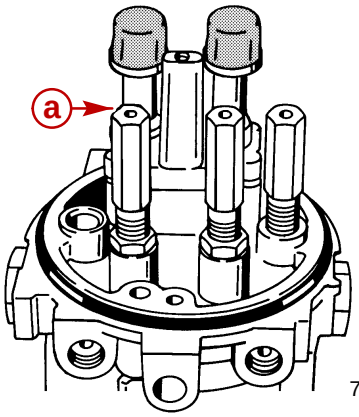
- **a** - Original Factory Installed UP Pressure Relief Valve
- **b** - Jam Nut - Loosen Before Removing the Valve
- **c** - Be Sure to Remove the Pump Body Components (Spring, eyelet, Check Ball) - Discard
- **d** - Replacement UP Pressure Relief Valve (Blue) - Use the Base of the valve for tightening
- **e** - Jam Nut - DO NOT TURN or Attempt to Loosen
- **f** - O-ring

DOWN Pressure Relief Valve Replacement

NOTE: *The DOWN pressure relief valve in the kit is color coded green for easy identification.*

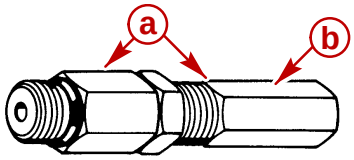
IMPORTANT: A difference exists between the factory installed and the replacement pressure relief valves. Once the jam nut is loosened on a factory installed relief valve, the valve is out of adjustment.

IMPORTANT: When installing a replacement pressure relief valve, DO NOT loosen or attempt to remove the hex "jam" nut. This valve is preset at the factory for proper DOWN pressure relief.



70872

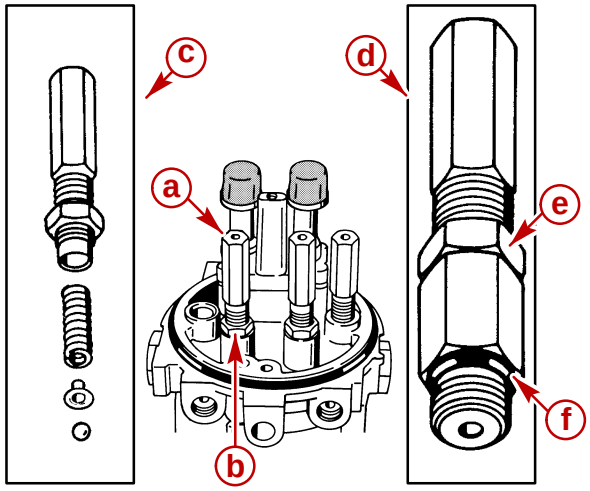
a - Factory Installed DOWN Pressure Relief Valve



50396

a - Replacement DOWN Pressure Relief Valve
b - Color Coded Green Area

1. Replace the DOWN pressure relief valve. Remove the pump body components and discard. Ensure that the threaded hole is free of dirt. Lubricate the O-ring at the base of the new valve with Power Trim and Steering Fluid and install. Torque to 70 lb-in. (7.9 Nm). Use the base of the valve for tightening; DO NOT TURN or attempt to loosen the jam nut.



Original Factory Installed Pressure Relief Valve

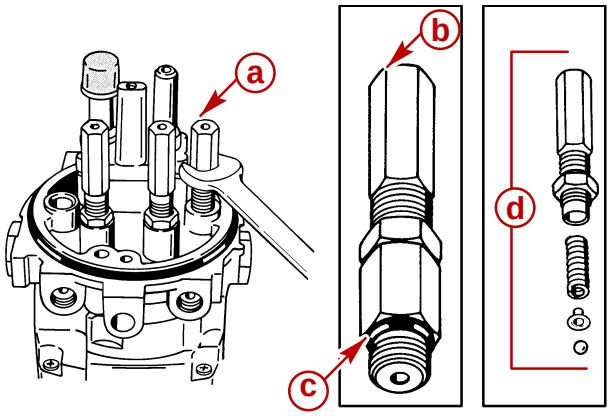
- **a** - Original Factory Installed DOWN Pressure Relief Valve
- **b** - Jam Nut - Loosen Before Removing the Valve
- **c** - Pump Body Components (Spring, Eyelet, Check Ball)
- **d** - Replacement DOWN Pressure Relief Valve (GREEN)
- **e** - Jam Nut
- **f** - O-ring

Thermal Relief Valve Replacement

NOTE: *The Thermal Relief Valve in the kit is color coded gold for easy identification.*

IMPORTANT: The thermal relief valve is factory preset. DO NOT loosen or attempt to separate the component parts. Do not use a wrench on the upper gold colored fitting. Use a wrench on the lower hex-fitting to tighten the relief valve.

1. Replace the thermal relief valve. Remove the pump body components and discard. Ensure that the threaded hole is free of dirt. Lubricate the O-ring at the base of the new valve with Power Trim and Steering Fluid and install. Torque to 70 lb-in. (7.9 Nm). Use the base of the valve for tightening; DO NOT TURN or attempt to loosen the jam nut.



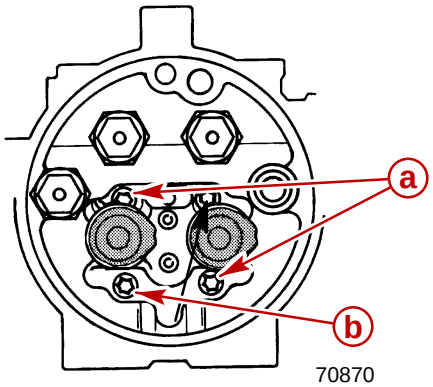
70836

a - Thermal Relief Valve
b - Replacement Thermal Relief Valve (Gold)
c - O-ring
d - Pump Body Components (Spring, Eyelet, Check Ball)

Pump Replacement

NOTE: *The pump is cannot be re-built. If the pump is defective, replace it as an assembly.*

1. Remove the pump attaching screws with a hex lobular socket or standard 3/16 in. (5 mm) socket and the pump. Do NOT loosen the pump assembly screws.

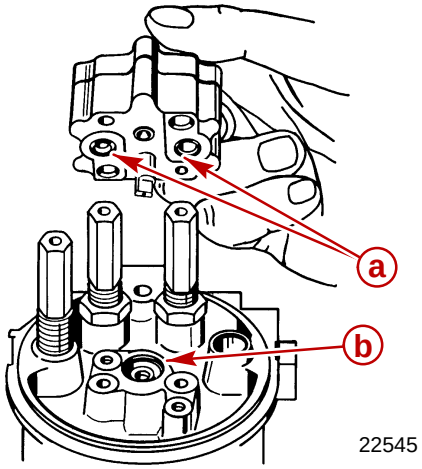


70870

a - Screw
b - Pump Assembly Screws

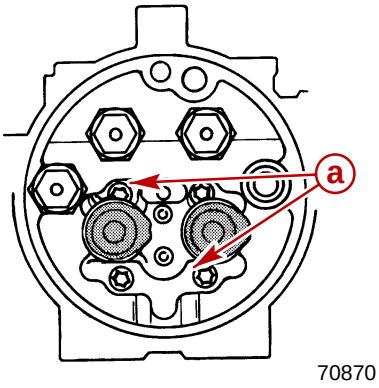
2. Remove the O-rings from the old pump and install them on the new pump.

3. Lubricate the lip of the adapter seal with light weight oil.



a - O-rings
b - Adapter Seal

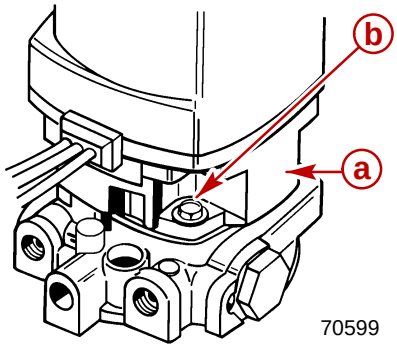
4. Install the pump and torque the pump screws to 70 lb-in. (7.9 Nm) using a hex lobular socket or standard 3/16 in. (5 mm) socket.



a - Screws

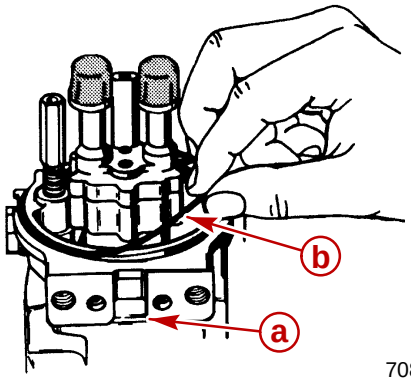
Adapter Replacement

1. Remove the pump motor attaching screws and remove the pump motor.



a - Pump Motor
b - Screws (2)

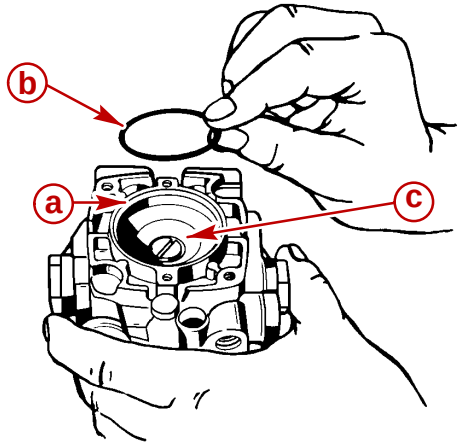
2. Remove and discard the adapter to reservoir O-ring.



a - Adapter
b - O-ring

3. Remove and discard the motor to adapter O-ring.
4. If present, remove the vent screw (dipstick) from the old adapter.
5. If present, install the vent screw (dipstick) and new O-ring into the new adaptor.

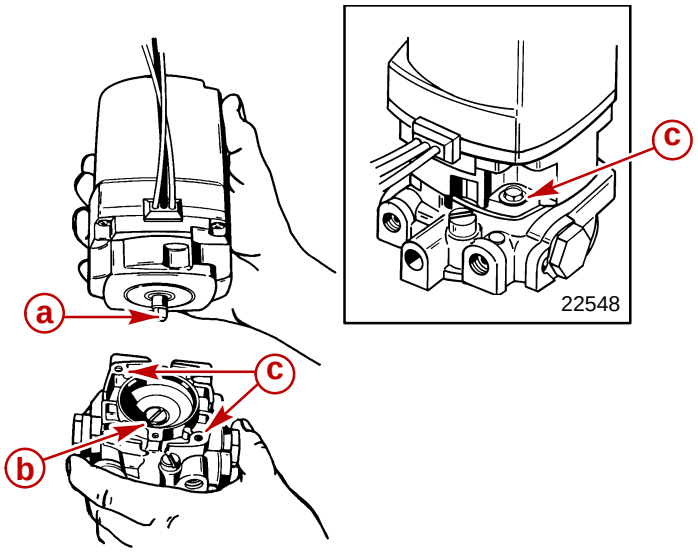
6. Ensure that the coupling is installed so that the shallow slot is toward the reservoir. Lubricate the coupling with 2-4-C Marine Lubricant with Teflon.



70600

a - Adapter
b - O-ring
c - Coupling - (Shallow Slot Toward Reservoir)

7. Align the motor shaft with the coupling and install the motor onto the adapter. Position the motor as shown and secure with screws. Tighten securely.



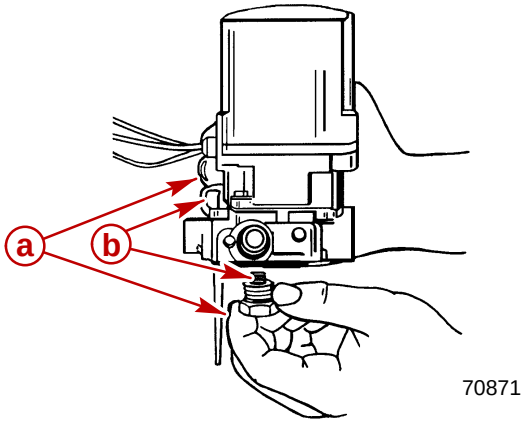
22496

a - Motor Shaft
b - Coupling
c - Screws (Opposite Corners)

Adapter Repair

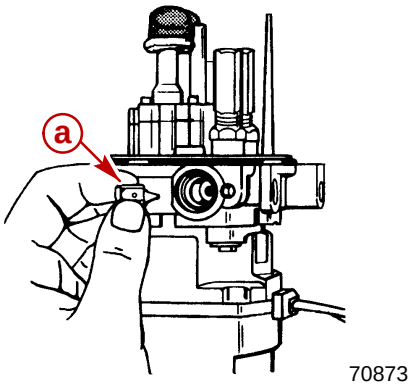
INTERNAL O-RING and POPPET VALVE REPLACEMENT

1. Remove the hex plug retainers and springs (one on each side).



a - Hex Plug Retainers (2)
b - Springs (2)

2. Remove and discard the poppet valves.

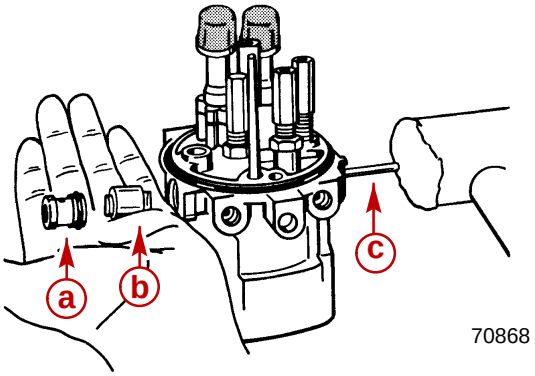


a - Poppet Valve

⚠ CAUTION

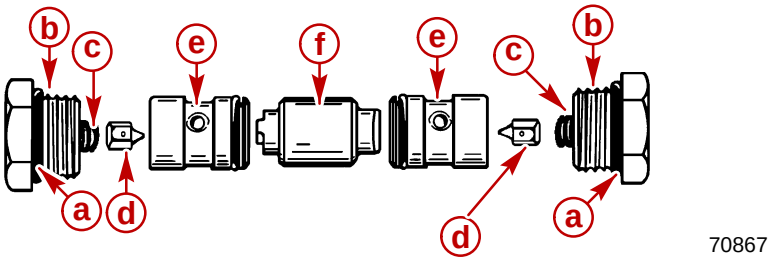
Use care in removing check valve bodies from adapter, so as not to damage poppet valve seat surface on valve body.

3. Remove the check valve bodies and spool, using 1/4 in. (6.35 mm) metal rod or punch. Ensure contact point on the valve bodies is NOT the sealing surface.



a - Check Valve Body
b - Spool
c - Small Punch

4. Remove and discard the O-rings on the hex plug retainers.
5. Discard the check valve bodies.
6. Clean the hex plug retainers and spool.



a - O-rings
b - Hex Plug Retainers
c - Springs
d - Poppet Valves
e - Check Valve Bodies
f - Spool

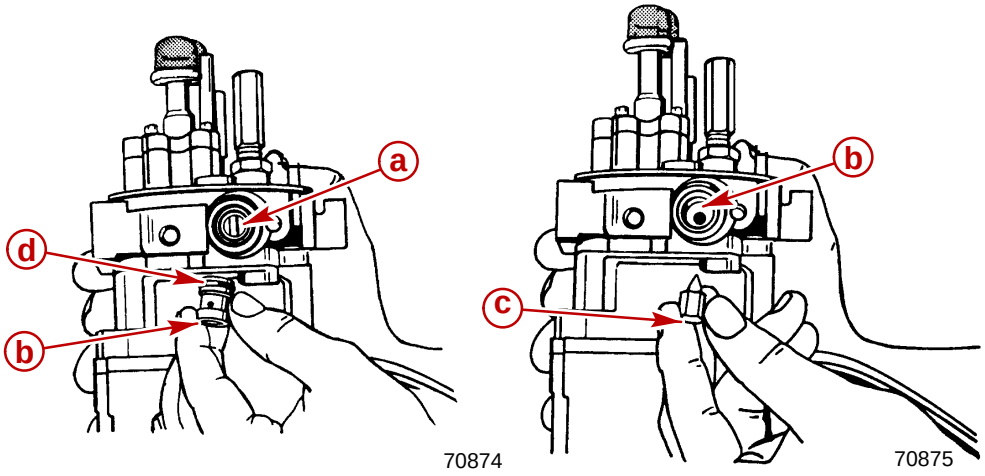
7. Lubricate the check valve body O-rings with Power Trim and Steering Fluid, or with 10W-30 or 10W-40 motor oil.

⚠ CAUTION

DO NOT force check valve bodies into adapter as damage to O-rings may result.

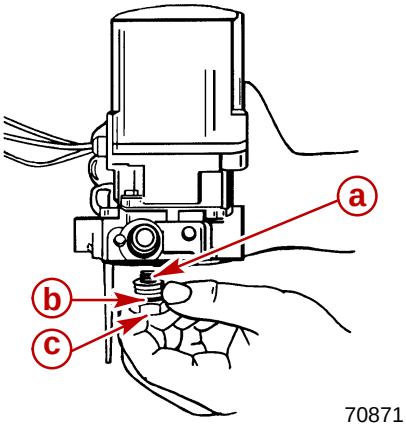
8. Place the spool and check valve bodies into the adapter.

9. Place the poppet valves into the check valve bodies.



a - Spool
b - Check Valve Body (2)
c - Poppet Valve (2)
d - Check Valve Body O-ring

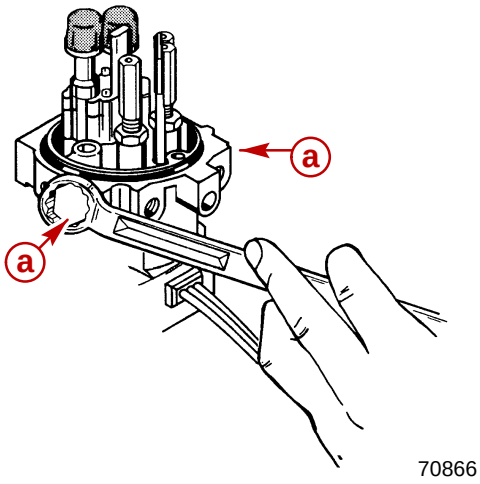
10. Lubricate the hex plug retainer O-rings with Quicksilver Power Trim and Steering Fluid, or 10W-30 or 10W-40 motor oil.
11. Place the springs into the hex plug retainers.
12. Thread the hex plug retainers into the adapter by hand until the retainer contacts the check valve body.



a - Spring (2)
b - O-ring
c - Hex Plug Retainer (2)

Hex plug retainers MUST BE turned into adapter exactly as outlined or damage to check valve body O-rings may result.

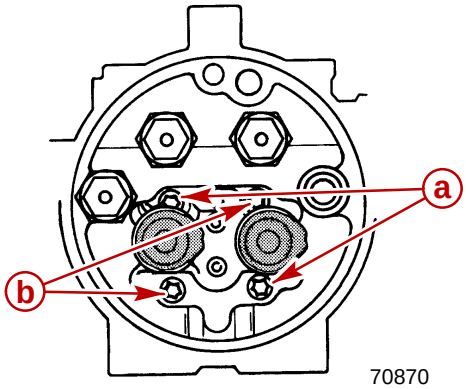
13. Tighten the hex plug retainer securely on each side.



a - Hex Plug Retainer

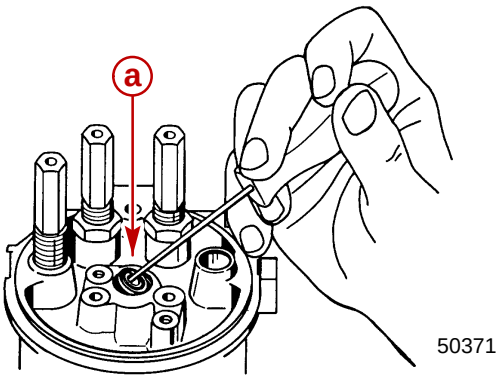
Pump Shaft Oil Seal Replacement

1. Remove the pump attaching screws with a hex lobular socket or standard $^{3}/_{16}$ in. (5 mm) socket. Remove pump. DO NOT loosen or remove the pump assembly screws.



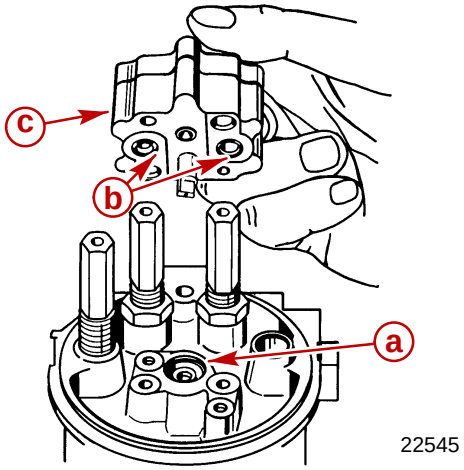
a - Screw
b - Pump Assembly Screw

2. Remove the oil seal by prying out with a screwdriver.



a - Oil Seal

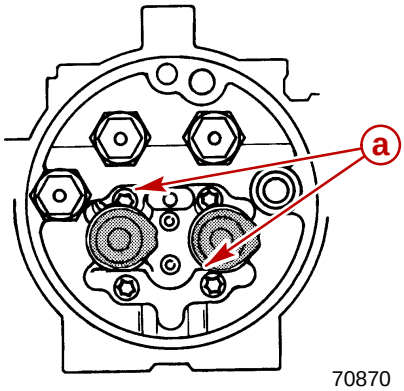
3. Remove and replace the O-rings on the pump base if they are worn.
4. Install a new seal with the lips toward the pump. The oil seal can be pressed in by hand.
5. Lubricate the lip of the seal with light weight oil.



22545

a - Oil Seal
b - O-rings
c - Pump

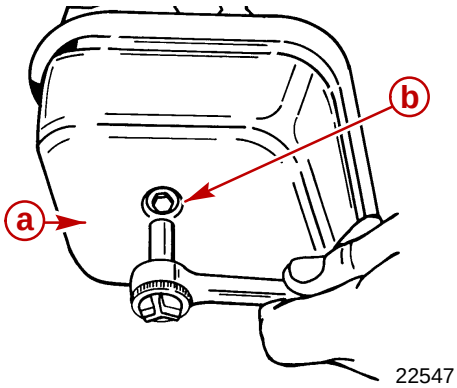
6. Install the pump and torque the attaching screws to 70 lb-in. (7.9 Nm) using a hex lobular socket or standard 3/16 in. (5 mm) socket.



70870

a - Screws

7. Install the pump reservoir.



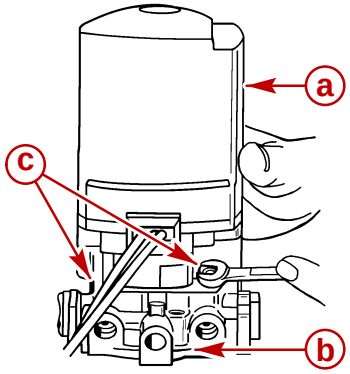
22547

a - Pump Reservoir
b - Bolt and O-ring - Spacer

Motor Repair

Disassembly

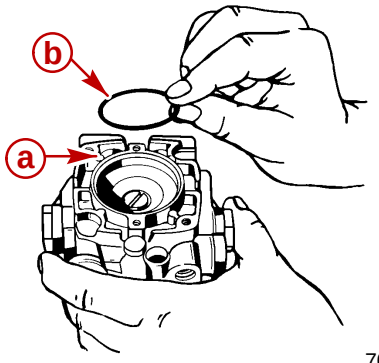
1. Remove the trim motor from the adapter.



70363

a - Trim Motor
b - Adapter
c - Screws

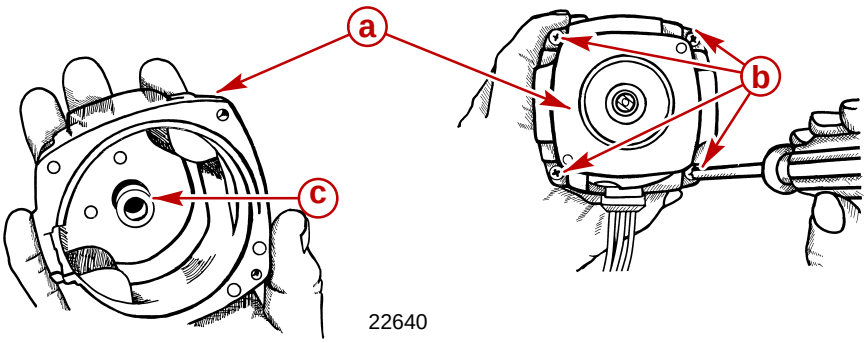
2. Remove the motor to adapter O-ring.



70600

a - Adapter
b - O-ring

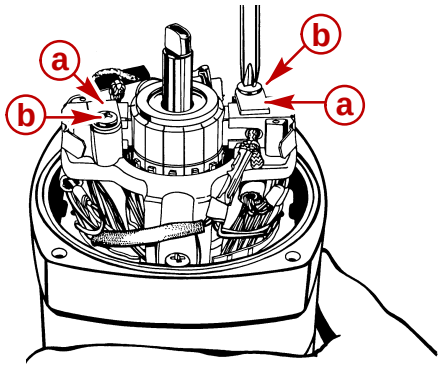
3. Remove the motor end cover and washer from the armature shaft bushing.



22640 22639

a - Cover
b - Screws (4)
c - Washer

4. Loosen the brush hold down arms.

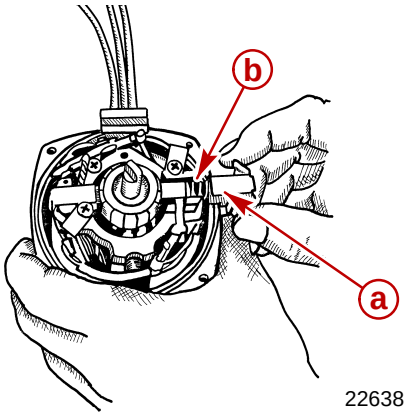


22648

a - Brush Hold Down Arms
b - Screws

IMPORTANT: Use care in removing brush holders so as not to lose springs.

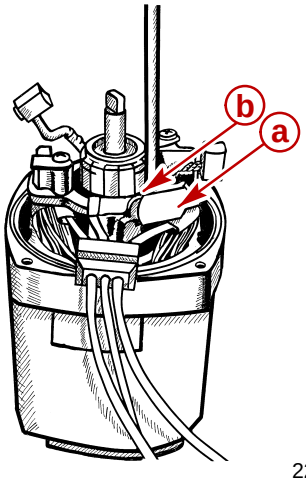
5. Remove the brush holders and springs.



22638

a - Brush Holder
b - Spring

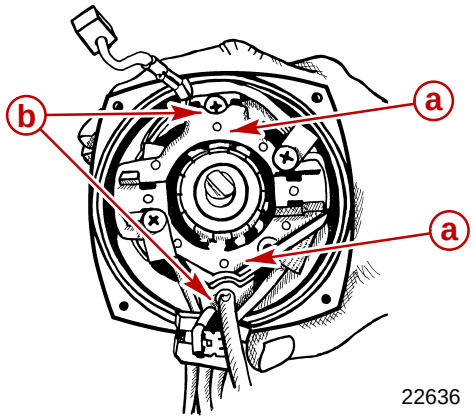
6. Remove the thermal switch and brush assembly.



22637

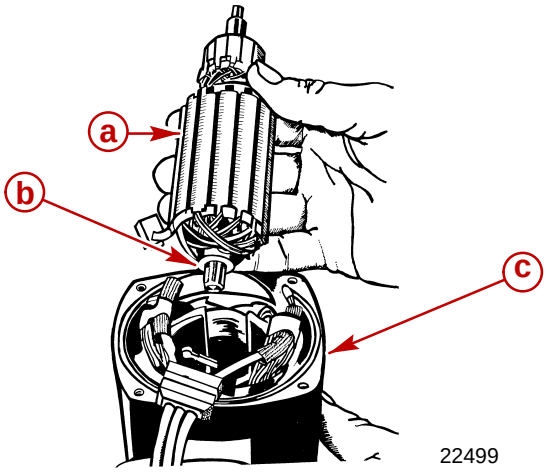
a - Thermal Switch and Brush
b - Screw

7. Remove the brush assembly mounting bracket.



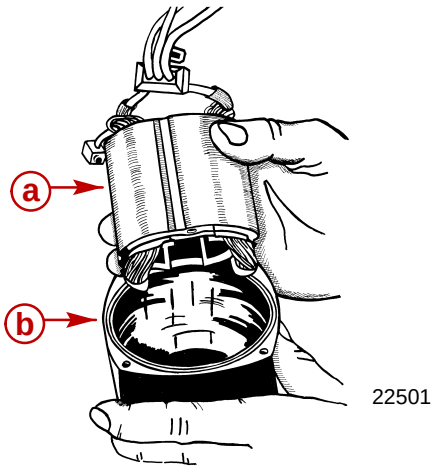
a - Brush Assembly Bracket
b - Screws

8. Remove the armature and thrust washer from the motor housing.



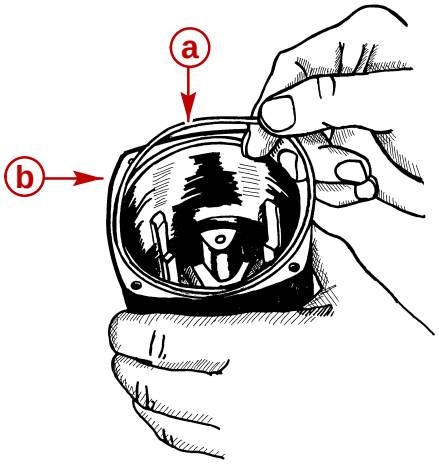
a - Armature
b - Thrust Washer
c - Motor Housing

9. Remove the field assembly from the motor housing.



a - Field Assembly
b - Motor Housing

10. Remove the motor housing O-ring.



22645

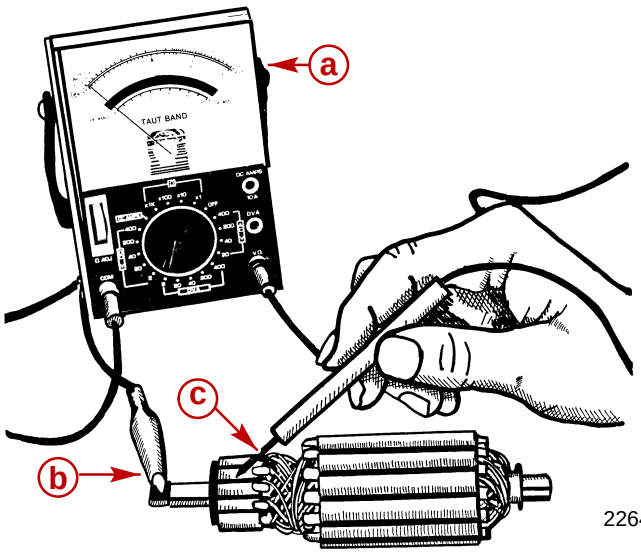
a - O-ring
b - Motor Housing

Armature Tests

Continuity Test

1. Set the ohmmeter on the Rx1 scale.
2. Place the alligator clip meter lead on the armature shaft.
3. Touch the meter lead probe to each commutator bar one at a time.

Continuity Indicated - Armature grounded (replace armature).
Continuity Not Indicated - Armature not grounded.



22646

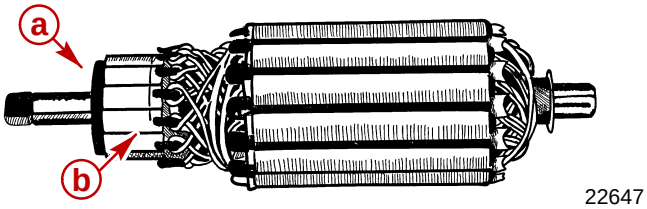
a - Ohmmeter - Set on Rx1 Scale
b - Meter Lead - Place on Armature
c - Meter Lead - Place on All Commutator Bars (One at a time)

Test for Shorts

1. Check the armature on a growler (follow the growler manufacturers instructions). Replace the armature if it has a short.

Cleaning Commutator

1. Clean the commutator with “00” garnet grit sandpaper. DO NOT use emery paper.
2. Check the gaps between the commutator bars for material. Remove material if present.



22647

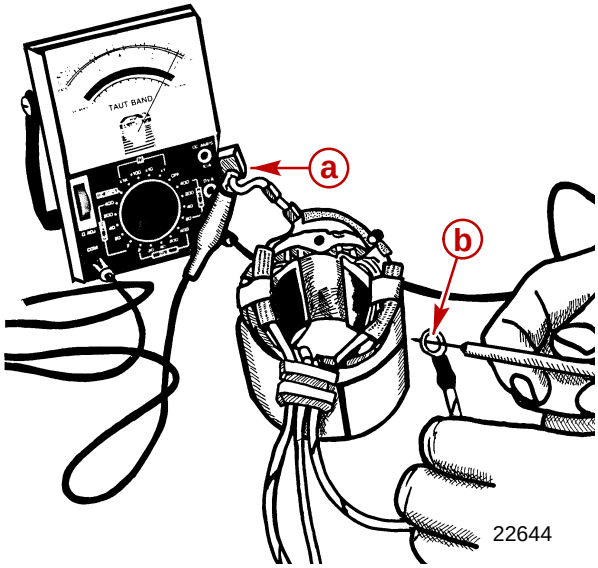
a - Commutator
b - Gap

Field Tests

Test for Open Circuit

1. Connect the ohmmeter between the field brush lead and the blue-white lead.

- **Zero ohms indicated** (full continuity) - Field OK.
- **Zero ohms not indicated** (no continuity) - Replace field assembly.

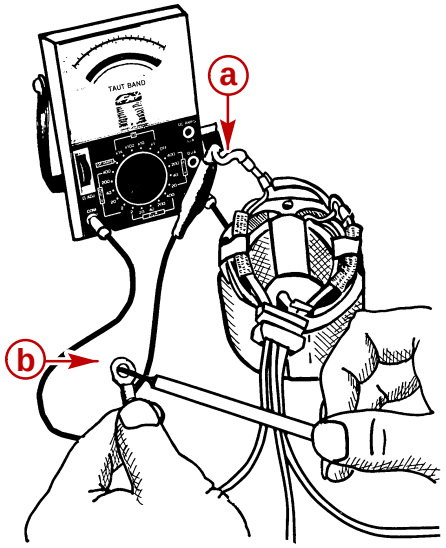


22644

a - Ohmmeter Lead - Connected to Brush Lead
b - Ohmmeter Lead - Connected to Blue/White Lead

2. Connect the ohmmeter between the field brush lead and the green-white lead.

- **Zero ohms indicated** (full continuity) - Field OK.
- **Zero ohms not indicated** (no continuity) - Replace field assembly.

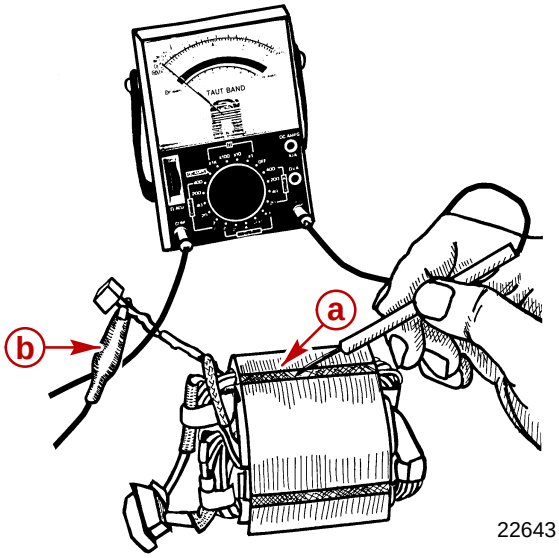


a - Ohmmeter Lead - Connected to Brush Lead
b - Ohmmeter Lead - Connected to Green/White Lead

Test for Short in Field

1. Connect the ohmmeter between the field brush lead and the field frame.

- **Zero ohms indicated** (full continuity) - Short indicated (replace field assembly).
- **Zero ohms not indicated** (no continuity) - Field OK.

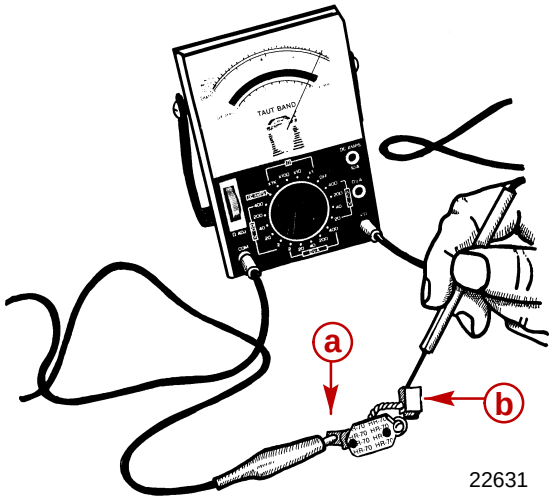


a - Field Frame
b - Field Brush Lead

Thermal Switch Continuity Test

1. Connect the ohmmeter between the spade connector and the brush lead.

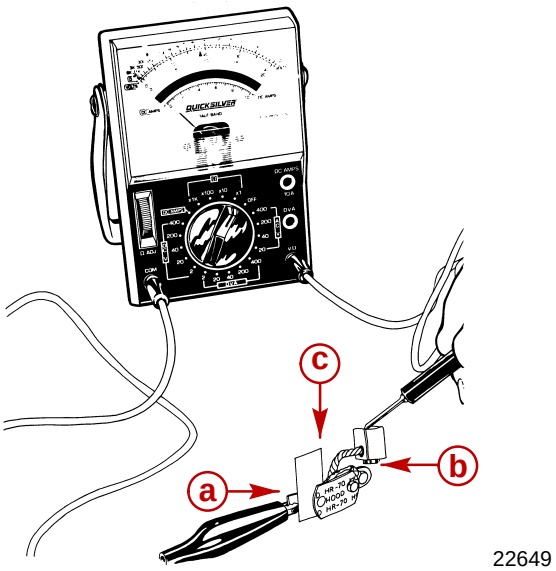
- **Zero ohms indicated** (full continuity) - Proceed to next step.
- **Zero ohms not indicated** (no continuity) - Replace thermal switch.



a - Thermal Switch Spade Connector
b - Brush Lead

2. Insert an insulator (piece of paper) between the contact points on the ohmmeter (between spade connector and brush lead).

- **Zero ohms indicated** (full continuity) -Replace thermal switch.
- **Zero ohms not indicated** (no continuity) - Thermal switch OK.

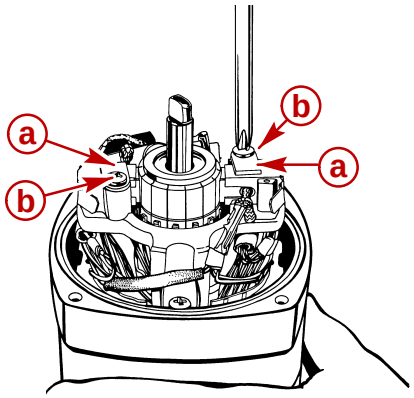


a - Thermal Switch Spade Connector
b - Brush Lead
c - Insulator (Piece of Paper)

3. Remove the insulator from between the contact points on the thermal switch. Clear all material away from the points.

Brush Replacement

1. Loosen the brush hold down arms.

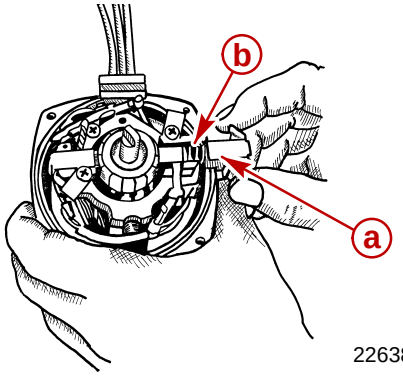


22648

a - Brush Hold Down Arms
b - Screws

IMPORTANT: Use care in removing brush holders so as not to lose springs.

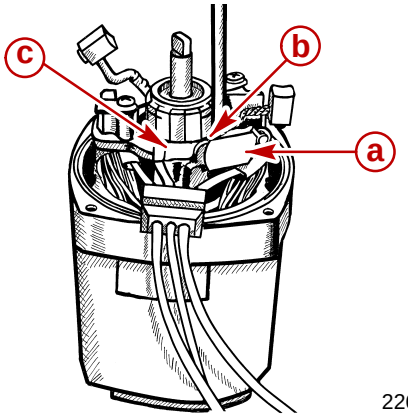
2. Remove the brush holders and springs.



22638

a - Brush Holder
b - Spring

3. Remove the thermal switch and brush assembly.

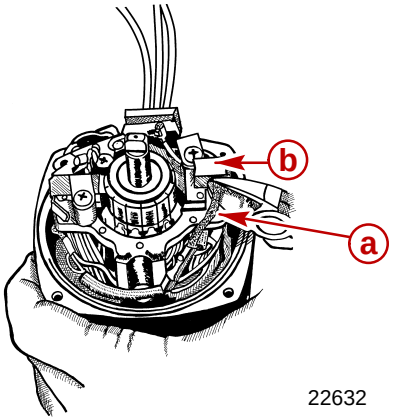


22637

a - Thermal Switch and Brush
b - Screw
c - Connector

IMPORTANT: When replacing the brush that is connected to the field wires; cut the brush wire as close to the brush as possible.

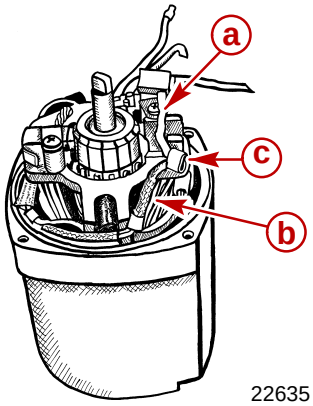
4. Cut the brush wire as close to the brush as possible and discard the brush.



22632

a - Brush Wire
b - Brush

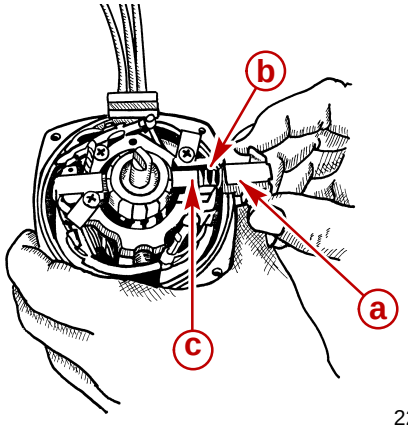
5. Connect the new brush wire to the field wire cut in the previous step. Secure by crimping both wires together as shown.



22635

a - Brush Wire
b - Field Wire (Old Brush Wire)
c - Crimp Connector

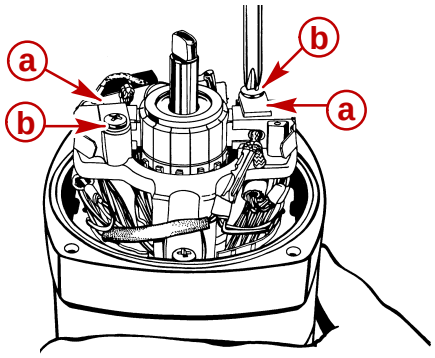
6. Reinstall the spring and brush in the brush holder.



22638

a - Brush Holder
b - Spring
c - Brush

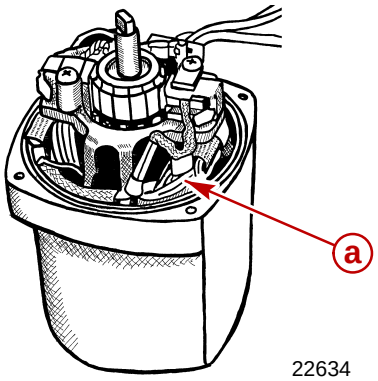
7. Position the brush hold down arms and tighten them securely. DO NOT OVERTIGHTEN.



22648

a - Brush Hold Down Arms
b - Screws

8. Position the brush wire as shown before reassembly.

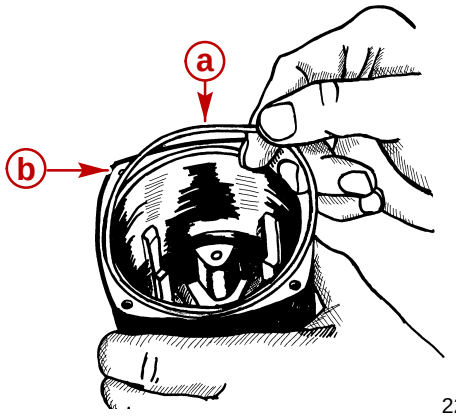


22634

a - Brush Wire

Reassembly

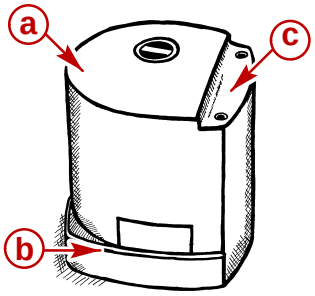
1. Install the motor housing O-ring.



22645

a - O-ring
b - Motor Housing

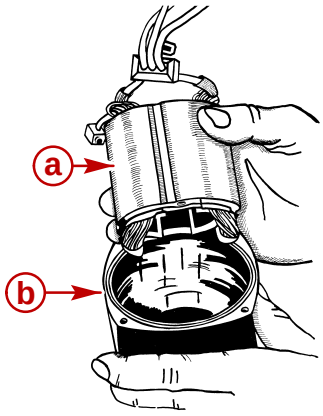
IMPORTANT: The field assembly wires must face the front of the motor housing. Use the notched area in the housing as a reference in determining the front.



22633

a - Motor Housing
b - Front
c - Notched Area

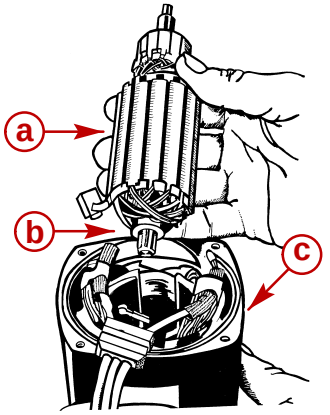
2. Install the field assembly into the motor housing.



22501

a - Field Assembly
b - Motor Housing

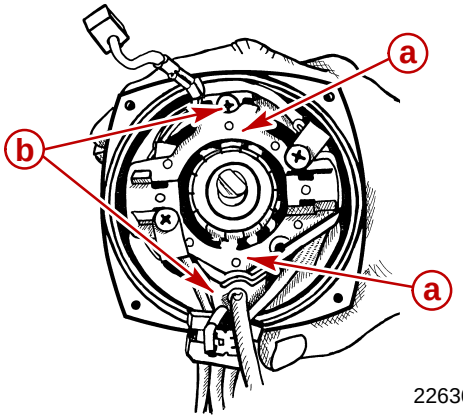
3. Install the thrust washer on the armature and install the armature into the motor housing.



22499

a - Armature
b - Thrust Washer
c - Motor Housing

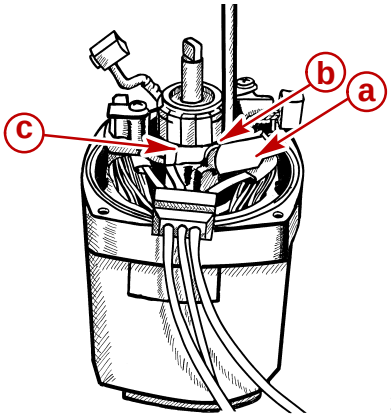
4. Install the brush assembly mounting. Tighten the screws securely.



22636

a - Brush Assembly Mounting Bracket
b - Screws

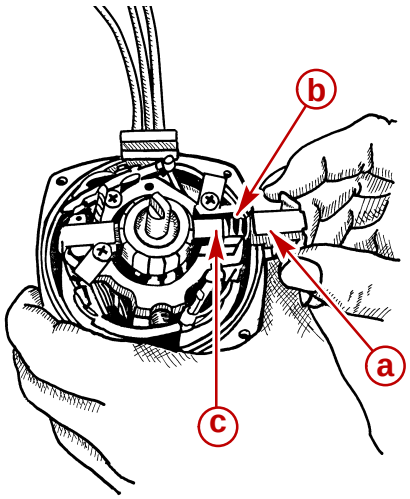
5. Install the thermal switch and connect the black wire. DO NOT overtighten the screw.



22637

a - Thermal Switch
b - Screw
c - Black Wire Connector

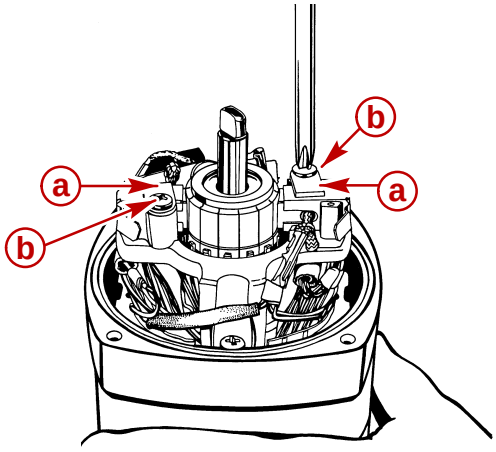
6. Install the springs and brushes in the brush holders.



22638

a - Brush Holders
b - Springs
c - Brushes

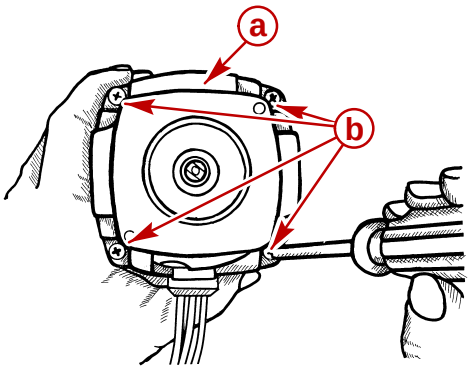
7. Position the brush holders and secure them with the brush hold down arms. DO NOT overtighten the screws.



22648

a - Brush Hold Down Arms
b - Screws

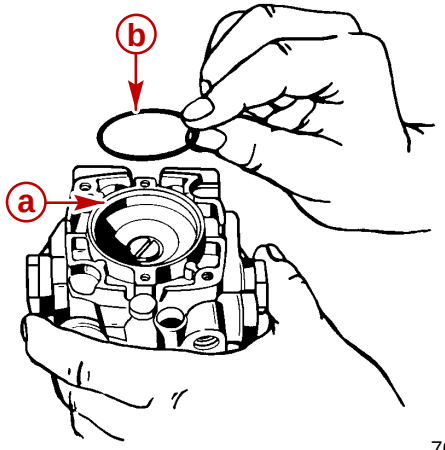
8. Install the motor end cover. Apply Loctite 27131 to the screws and tighten securely. DO NOT overtighten.



22639

a - Motor End Cover
b - Screws

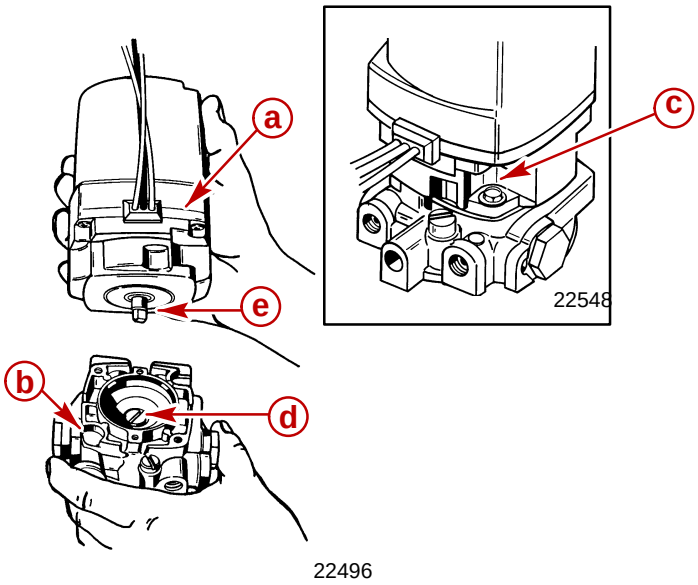
9. Install the motor to adapter O-ring.



70600

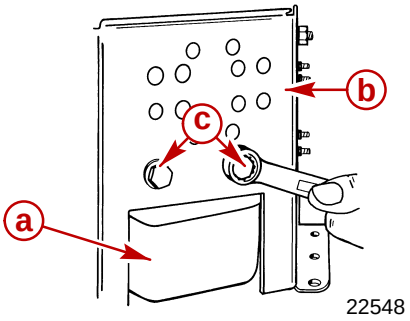
a - Adapter
b - O-ring

10. Align the motor shaft with the coupler and install the trim motor on the adapter. Torque the screws to 25 lb-in. (2.8 Nm).



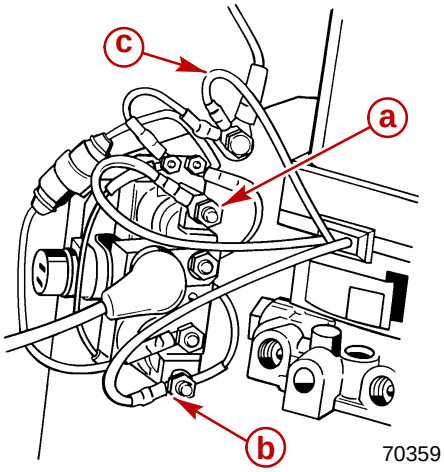
a - Trim Motor
b - Adapter
c - Screws (2 in Opposite Corners)
d - Coupler
e - Motor Shaft

11. Install the trim pump on the floor bracket. Tighten securely.



a - Trim Pump
b - Floor Bracket
c - Screws and Lock Washers

12. Connect the trim motor wires to solenoids as shown.

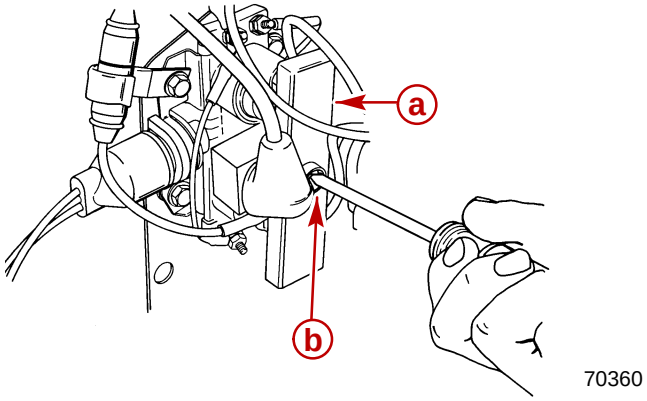


a - Blue/White Motor Wire
b - Green/White Motor Wire
c - Black Ground Wire

⚠ CAUTION

Solenoid terminal cover screw is attached to 12 volt positive source. DO NOT GROUND the screw driver when installing cover.

13. Install the solenoid terminal cover. Tighten the screw securely.



a - Solenoid Terminal Cover
b - Screw

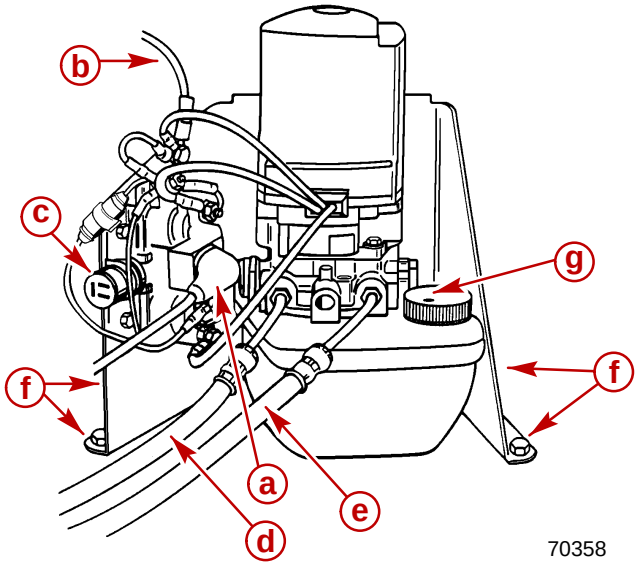
Trim Pump Installation

1. Secure the pump and mounting bracket to the boat using lag bolts and washers.
2. Reconnect the trim hoses to the pump; black hose to the left connection, gray hose to the right connection. DO NOT cross-thread or overtighten the hose fittings. Torque the fittings to 110 lb-in. (12 Nm).
3. Reconnect the trim harness connector to the trim pump.
4. Reconnect battery leads to battery.

⚠ CAUTION

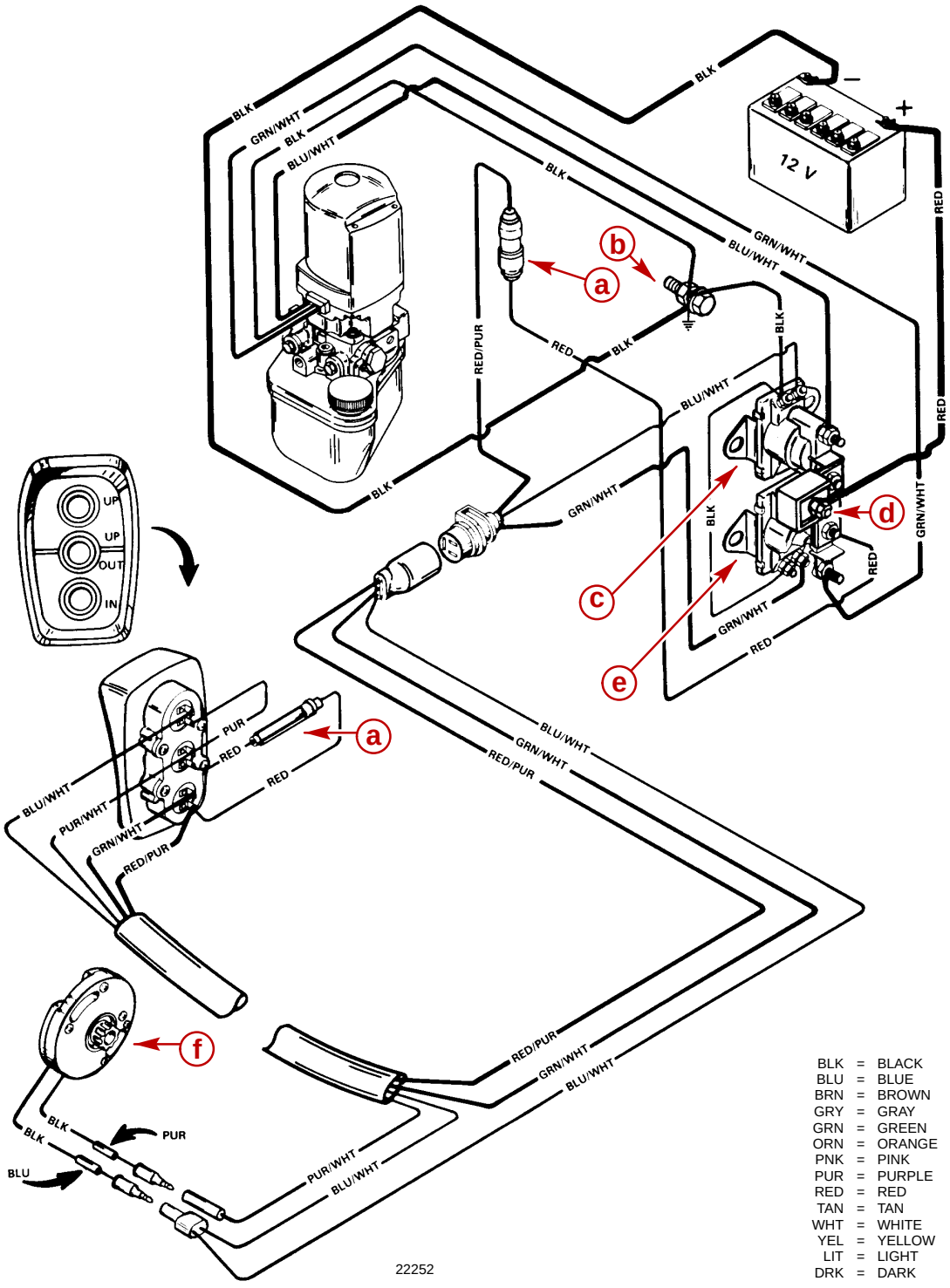
Fill cap is vented. Be sure to remove “Caplug” (fill neck seal) from fill neck on new replacement pumps. Failure to do this can damage pump, when operated.

5. Check the fluid level and fill if necessary. (Refer to “Maintaining Power Trim Pump Oil Level” in this section).



a - Positive Battery Lead
b - Negative Battery Lead
c - Harness Connector
d - Black Hydraulic Hose (UP Hose)
e - Gray Hydraulic Hose (DOWN Hose)
f - Lag Bolts and Washers
g - Vent in the Vented Fill Cap

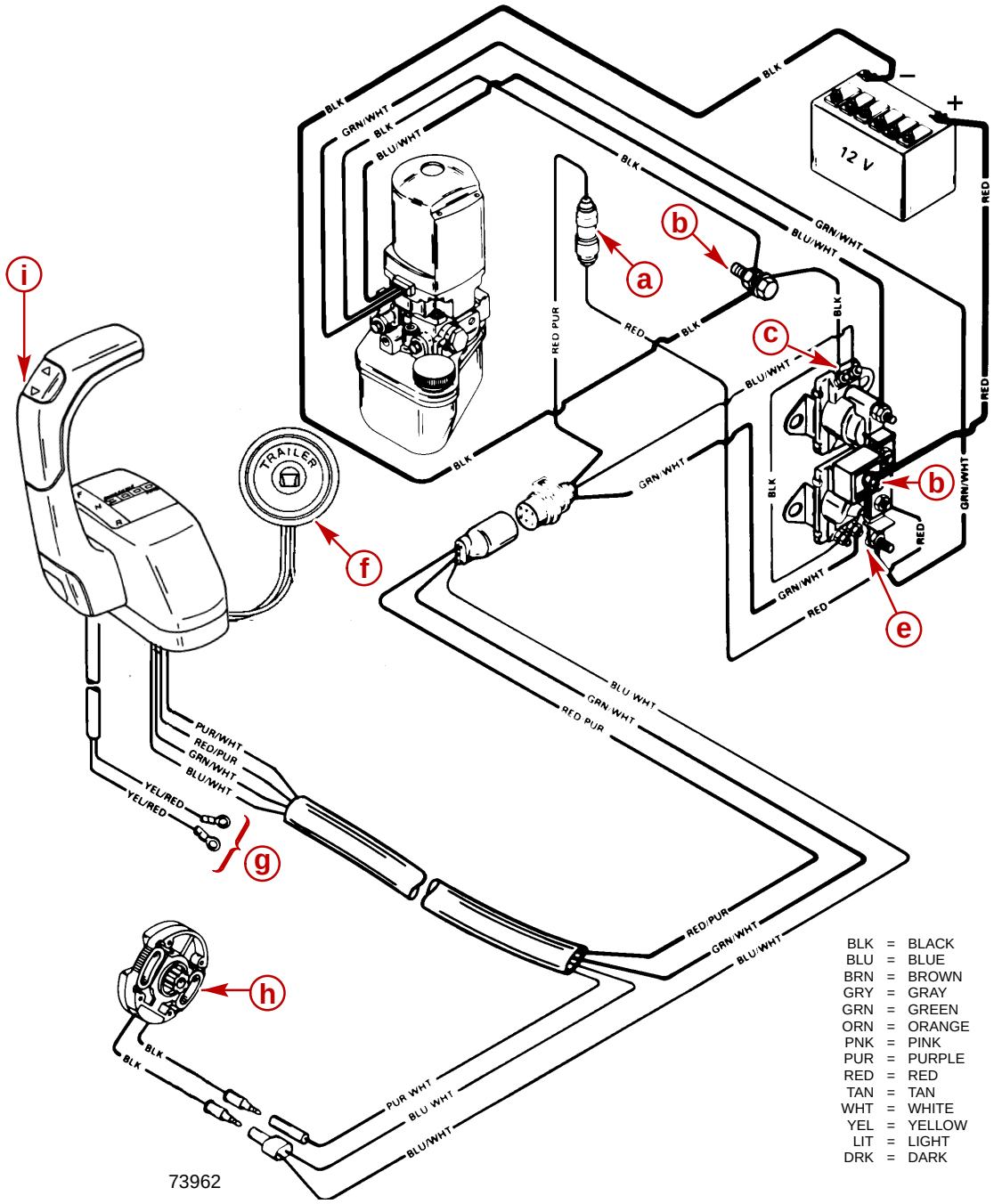
Trim Pump Wiring Diagrams



Model With Three-Button Trim/Trailer Panel

a - 20 Amp Fuse
b - Ground Bolt (Floor Mount)
c - UP Solenoid
d - DOWN Solenoid
e - Trim Limit Switch
f - 110 Amp Fuse

Model With Trim In Handle and Trailer Switch Separate



a - 20 Amp Fuse
b - Ground Bolt (Floor Mount)
c - UP Solenoid
d - 110 Amp Fuse
e - DOWN Solenoid
f - Trailer Switch
g - Neutral Switch To Instrument Wiring Harness
h - Trim Limit Switch
i - Trim Buttons

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POWER TRIM

Section 5B - Trim Cylinders

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Removal	5B-3
Disassembly	5B-5
Reassembly	5B-9
Installation	5B-15

5 B

Specifications

Torque Specifications

Description	Torque		
	lb-in.	lb-ft	Nm
Piston Rod Bolt		17.5	23.7
End Cap		45	61
Anode Screw	30		3.4

Special Tools

Description	Part Number
Spanner Nut Wrench	91-821709T
Large Pin Set	91-811907
Medium Pin Set	91-811908
Small Pin Set	91-811909

Lubricants/Sealers/Adhesives

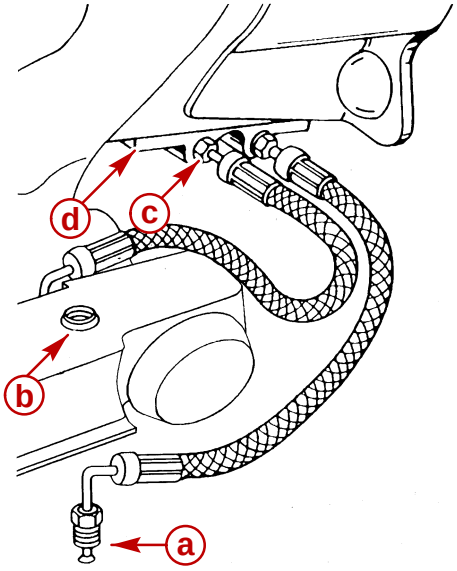
NOTE: *Prior to reassembly of trim cylinder(s), lubricate all internal parts with Quicksilver Power Trim and Steering Fluid or (if not available) 10W-30 or 10W-40 motor oil.*

Description	Part Number
Loctite 27131	92-809820
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12
Quicksilver Perfect Seal	92-34227--1
Quicksilver Power Trim and Steering Fluid	92-90100A12

Trim Cylinder Repair

Removal

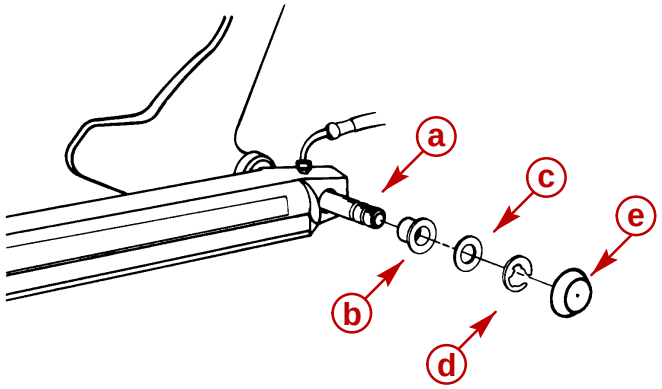
1. Disconnect UP trim hose from front hole on trim cylinder.
2. Disconnect DOWN trim hose from hydraulic connector on gimbal housing. Plug holes with suitable plug or (22-38609).



70261

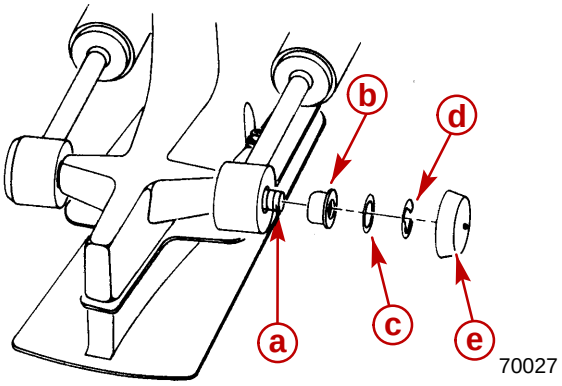
a - UP Hose
b - Front Hole On Trim Cylinder
c - DOWN Hose
d - Hydraulic Connector

3. Remove front and rear power trim cylinder mounting hardware.

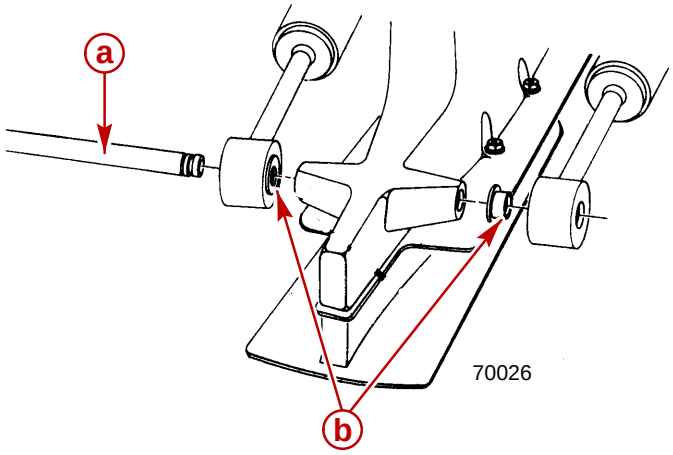


70176

a - Front Anchor Pin
b - Bushing (Port And Starboard) (4)
c - Flat Washer (Port And Starboard) (2)
d - E-ring (Port And Starboard) (2)
e - Plastic Caps (Port And Starboard) (2)



70027



70026

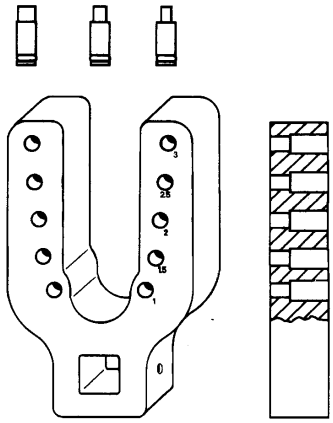
a - Rear Anchor Pin
b - Bushing (Port And Starboard) (4)
c - Flat Washer (Port And Starboard) (2)
d - E-ring (Port And Starboard) (2)
e - Plastic Caps (Port And Starboard) (2)

Disassembly

⚠ CAUTION

Ensure work area is clean before disassembling power trim cylinders. Cylinder parts can be damaged by dirt entering into power trim system.

NOTE: *Spanner Wrench Tool Part No. 91-821709.*

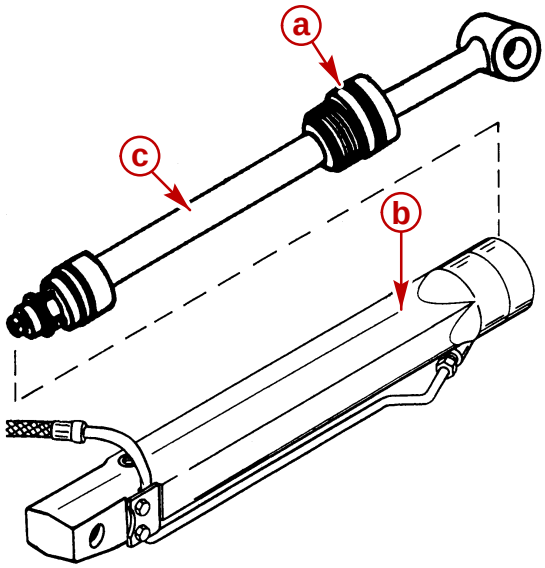


71233

⚠ CAUTION

DO NOT clamp center section of power trim cylinder during assembly or disassembly. Clamp cylinder on front mounting flange.

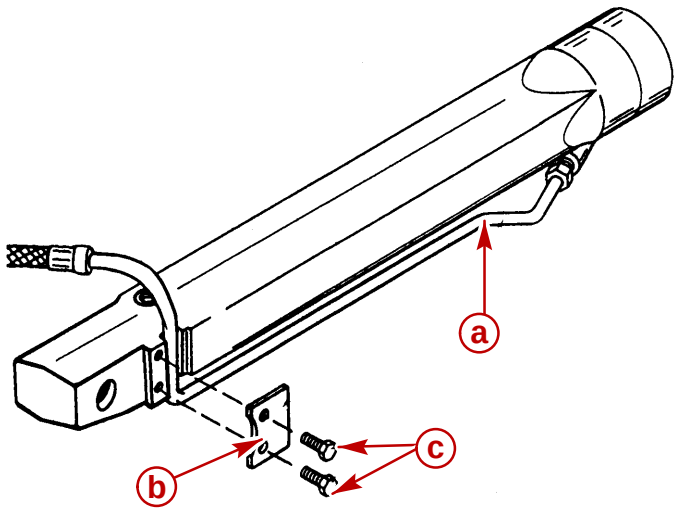
1. Loosen end cap with spanner wrench (91-821709) and remove piston rod assembly from cylinder.



70677

a - Cylinder
b - Piston Rod Assembly
c - Remove Down Trim Hose From Cylinder.

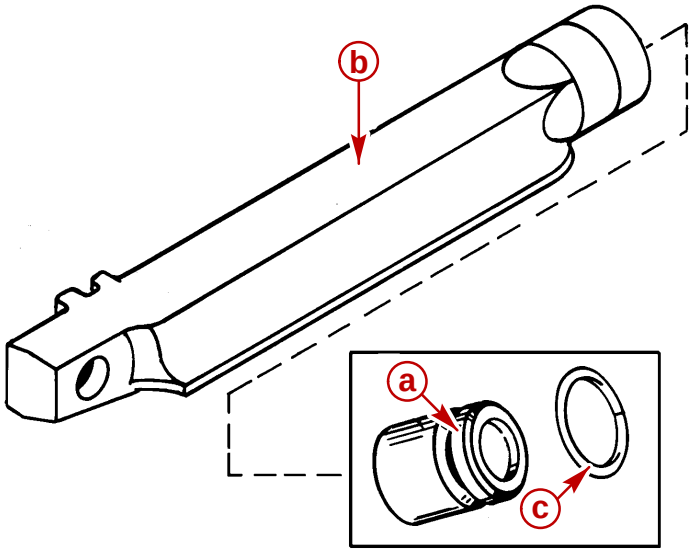
2. Remove DOWN trim hose from cylinder.



70678

a - DOWN Trim Hose
b - Clamping Plate
c - Screws

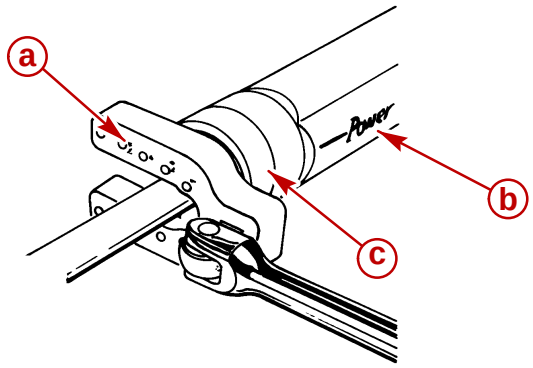
3. Remove floating piston from cylinder and remove O-ring.



22131

a - Floating Piston
b - Trim Cylinder
c - O-ring

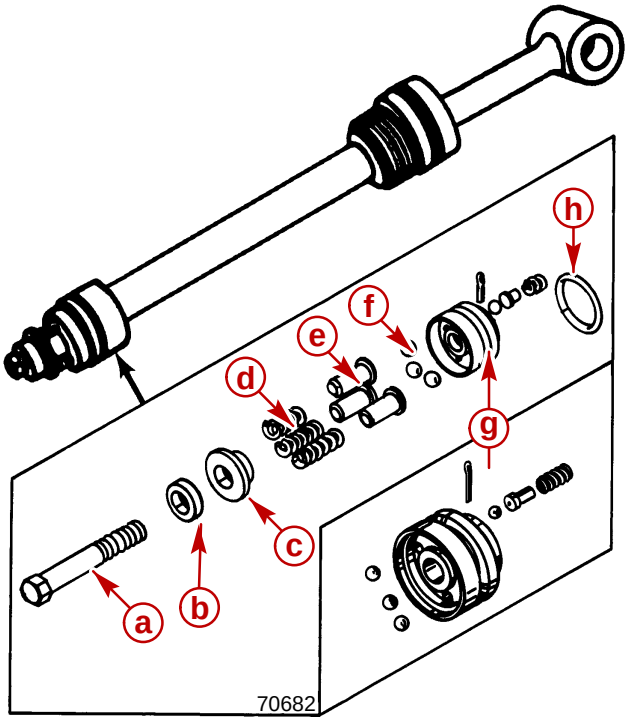
4. Remove trim cylinder end caps (Use special tool 91-821709).



71677

a - Special Tool 91-821709
b - Trim Cylinder
c - Trim Cylinder End Cap

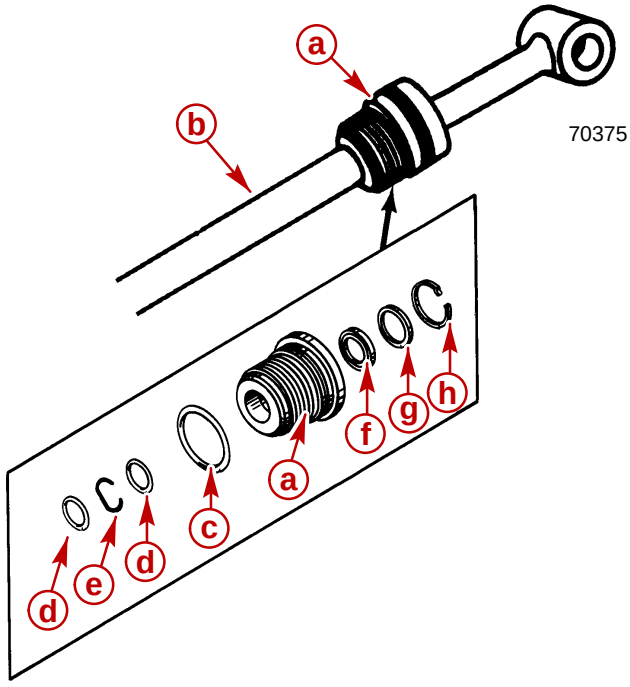
5. Remove and disassemble shock piston assembly. Be careful not to lose check balls. Refer to Reassembly section for explanation if spacer is missing from cylinder.



22132

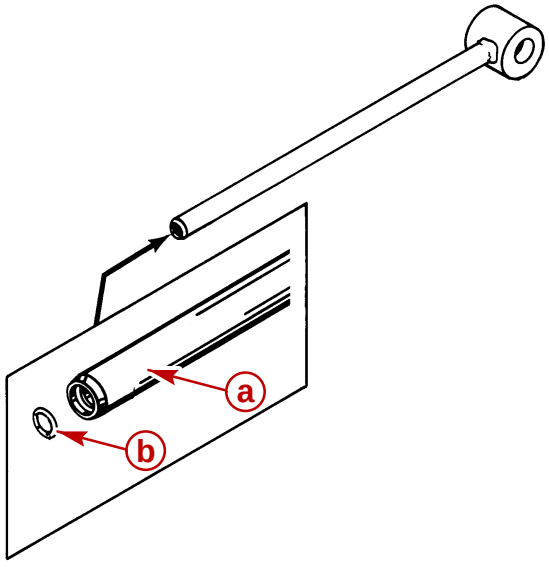
a - Bolt
b - Spacer
c - Washer
d - Springs (3)
e - Spring Pins (3)
f - Check Balls (3)
g - Shock Piston Assembly
h - O-ring

6. Remove and disassemble end cap.



a - End Cap
b - Piston Rod
c - Large O-ring
d - Small O-ring (2)
e - Continuity Spring
f - Rod Scraper
g - Plain Washer
h - Retaining Ring

7. Remove small O-ring from end of piston rod.



a - Small O-ring
b - Piston Rod

8. Clean all parts in solvent. Be sure all parts are dry before reassembly.

Reassembly

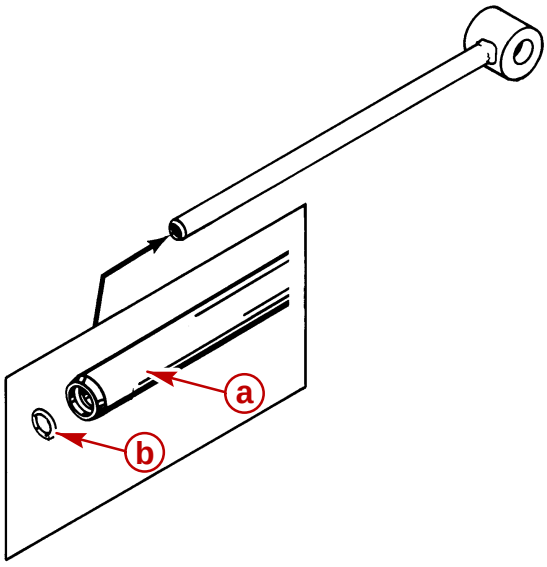
IMPORTANT: DO NOT attempt to substitute trim cylinders from different models or damage to drive unit and/or transom could result.

⚠ CAUTION

Ensure work area and all components are clean before reassembling trim cylinders. Power Trim components can become damaged if dirt gets into system.

NOTE: *Before reassembly, lubricate all internal parts with Quicksilver Power Trim and Steering Fluid or SAE 10W-30 or 10W-40 Motor Oil.*

1. Install small O-ring into end of piston rod.

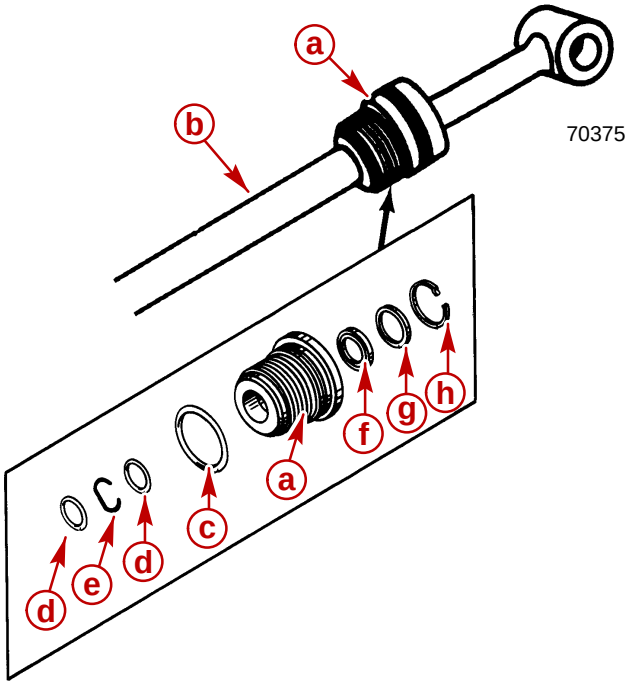


70682

a - O-ring
b - Piston Rod

2. Install small O-rings and continuity spring into end cap.
3. Install rod scraper, plain washer and retaining ring into end cap.
4. Install large O-ring onto outside diameter of end cap.

5. Install end cap onto piston rod.



a - End Cap
b - Piston Rod
c - Large O-ring
d - Small O-ring (2)
e - Continuity Spring
f - Rod Scraper
g - Plain Washer
h - Retaining Ring

6. Install large O-ring on shock piston.

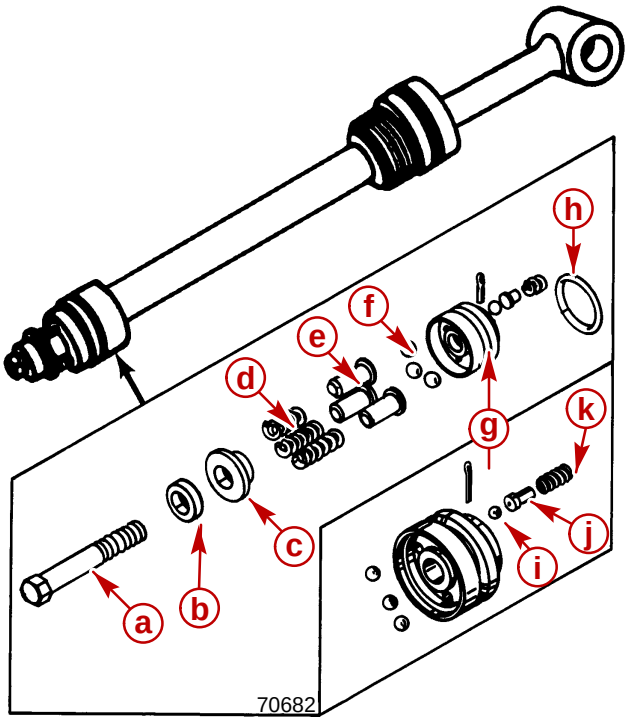
7. Install check ball, check ball eyelet, spring and spring pin into shock piston.

IMPORTANT: The new trim cylinders provide the capability for an increased Trim-in range. Spacer (u) can be removed from the trim cylinders to increase the Trim-in range by approximately 1-1/2 degrees. This will improve the acceleration on some boats by forcing the bow down more quickly. If spacers are to be removed, the boat must be tested to ensure the increased Trim-in range does not cause any undesired boat handling characteristics (bow-steer, chine-walk, etc.) if the drive is trimmed-in while the boat is operated at higher speeds. The boat should be tested under all conceivable load conditions and maneuvers to ensure that the additional Trim-in does not pose a problem. The final decision and responsibility for use of the additional Trim-in range is left up to the boat manufacturer.

⚠ WARNING

It is recommended that only qualified personnel perform the adjustment to the trim cylinders. Boat must be water tested after removing the spacers from the trim cylinders to ensure that the increased trim range does not cause the boat to exhibit an undesirable boat handling characteristic if the drive is trimmed in at higher speeds. The increased trim-in range may cause handling problems on some boats which could result in personal injury.

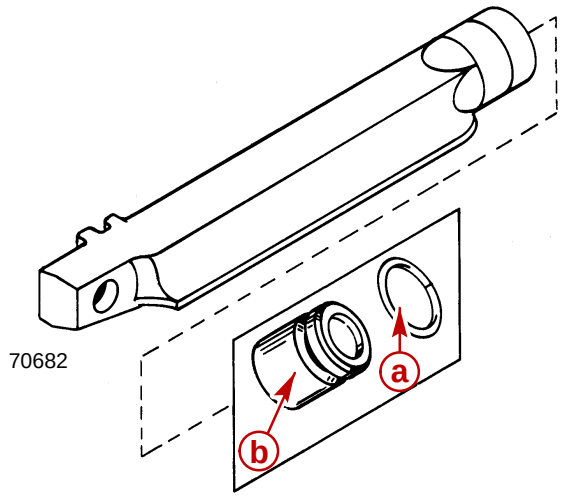
8. Install shock piston, three check balls, spring guide pins, springs, spring guide washer, spacer and bolt onto piston rod. Apply Loctite 27131 to threads of bolt. Torque to 17.5 lb-ft (23.5 Nm).



22132

a - Bolt
b - Spacer
c - Washer
d - Springs (3)
e - Spring Pins (3)
f - Check Balls (3)
g - Shock Piston Assembly
h - O-ring
i - Check Ball
j - Check Ball Eyelet
k - Spring Pin

9. Apply oil to parts. Install O-ring onto floating piston and insert floating piston into cylinder.

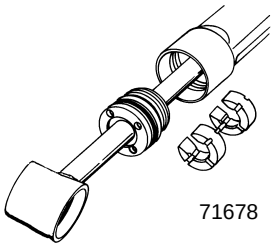


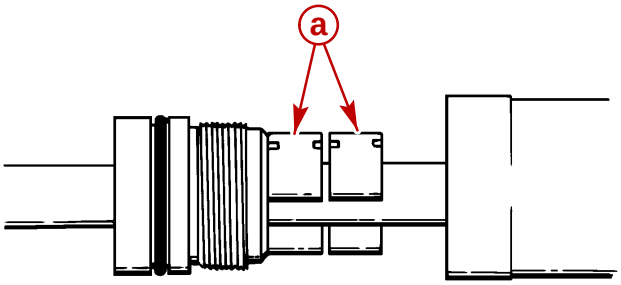
22131

a - O-ring
b - Piston
c - Cylinder

IMPORTANT: Some boat configurations may require tilt-limit spacers to limit the total upward travel of the drive unit. Be sure to install the same number of spacers that were originally removed. There must be an equal number in each cylinder.

10. If required, install tilt-limit spacers.





71679

a - Tilt Limit Spacers

⚠ CAUTION

Ensure work area and all components are clean before reassembling trim cylinders. Power Trim components can become damaged if dirt gets into system.

NOTE: *Before reassembly, lubricate all internal parts with Quicksilver Power Trim and Steering Fluid or SAE 10W-30 or 10W-40 motor oil.*

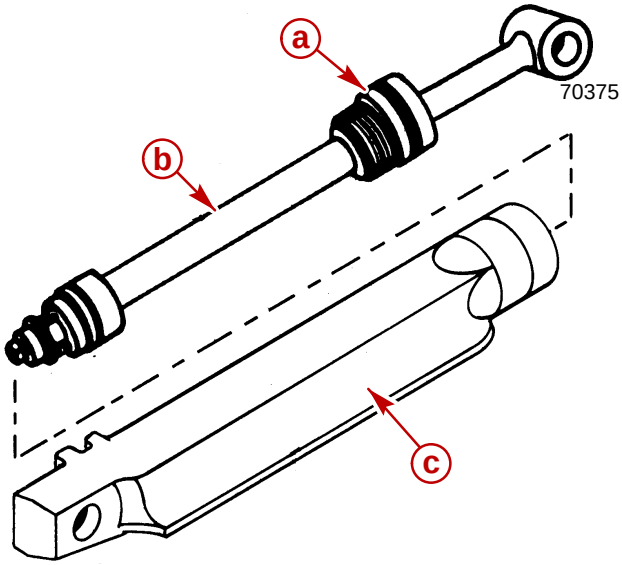
⚠ CAUTION

DO NOT clamp center section of trim cylinder during reassembly. If clamping of cylinder is necessary, clamp cylinder on front mounting flange.

⚠ CAUTION

Use only 2-4-C Marine Lubricant with Teflon on end cap threads. Other substances may act as an insulator and cause poor electrical continuity between cap and cylinder which could cause a corrosion problem.

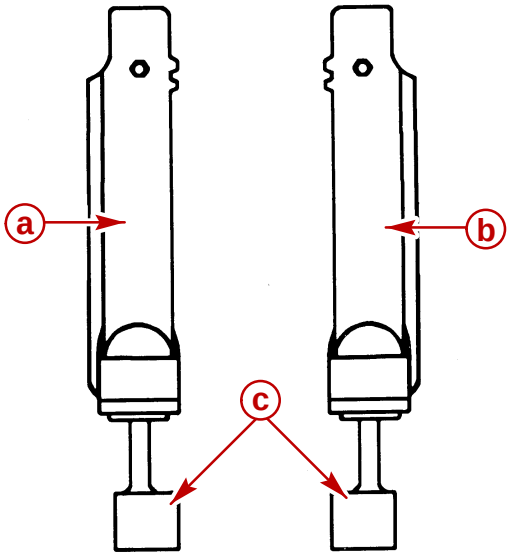
11. Apply Special Lubricant 101 to end cap threads and install piston rod assembly into cylinder. Tighten end cap securely using a spanner wrench.
12. Torque end cap at 45 lb-ft (61 Nm) using spanner wrench 91-821709.



70682

a - End Cap
b - Piston Rod Assembly
c - Cylinder

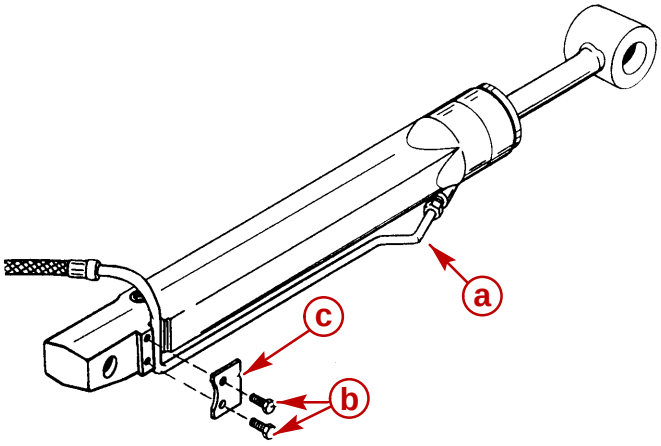
13. Position trim cylinder rear connecting ends as shown.



70380

a - Port Trim Cylinder
b - Starboard Trim Cylinder
c - Connecting Ends (Offset As Shown)

14. Install DOWN trim hose.

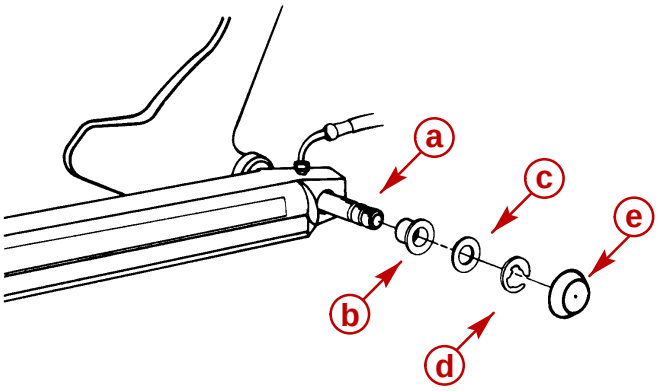


70676

a - DOWN Trim Hose
b - Clamping Plate
c - Screws
d - Check Painted Areas Of Trim Cylinders For Scratches That Expose Metal, Paint If Necessary.

Installation

1. Install trim cylinders forward mounting hardware as shown.
2. Coat area in trim cylinder between bushings with 2-4-C Lubricant with Teflon.
3. Replace anchor pin and install bushing(s) and washer(s).
4. Attach E-ring(s) and plastic cap(s) to end of anchor pin.

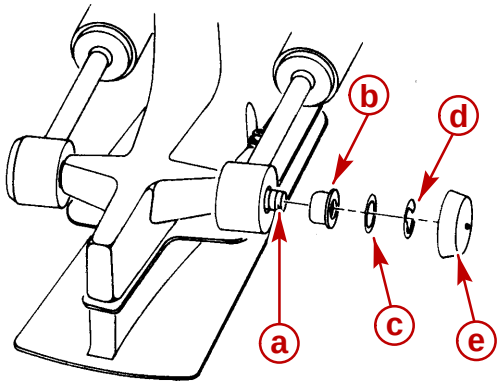


70176

a - Front Anchor Pin
b - Bushing (Port And Starboard) (4)
c - Flat Washer (Port And Starboard) (2)
d - E-ring (Port And Starboard) (2)
e - Plastic Caps (Port And Starboard) (2)

5. Install trim cylinders rear mounting hardware as shown.
6. Coat area in trim cylinder between bushings with 2-4-C Lubricant with Teflon.
7. Replace anchor pin and install bushing(s) and washer(s).

8. Attach E-ring(s) and plastic cap(s) to end of anchor pin.



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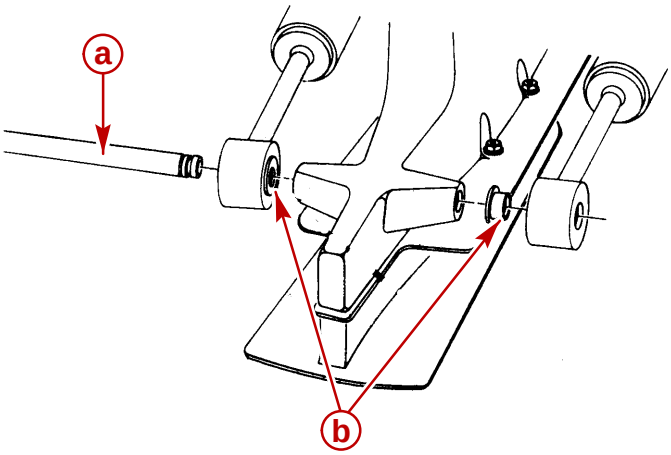

70026

a - Rear Anchor Pin
b - Bushing (Port And Starboard) (4)
c - Flat Washer (Port And Starboard) (2)
d - E-ring (Port And Starboard) (2)
e - Plastic Caps (Port And Starboard) (2)

9. Reconnect trim hoses after air bleeding power trim cylinders and hoses following procedures outlined in Section 5A. (See Table of Contents.)

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POWER TRIM

Section 5C - Dual Power Trim System

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5C

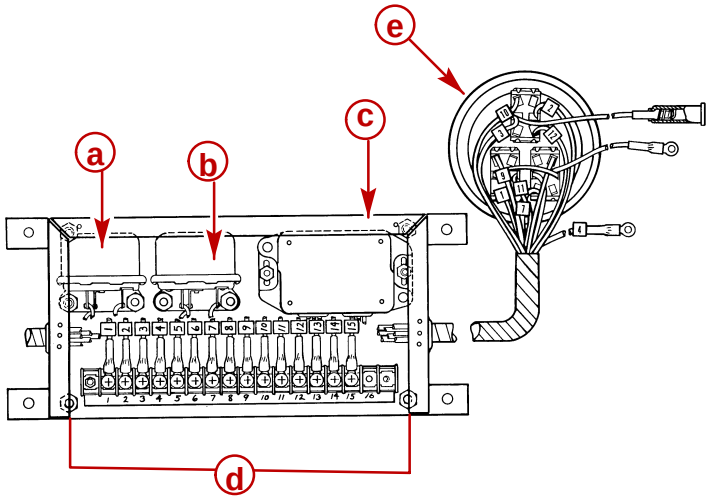
Important Information

When testing this Dual Power Trim system, take special note of the following:

- The control box harness connectors must be disconnected and the key switch must be OFF.
- Make certain that the jumper lead used between terminals 3 and 5 is used only when specified.

The following tests are listed in order of probable component failure. It is recommended, however, that all tests be performed even if a faulty component is detected early in the sequence. This precaution will guard against repeat failure if there is more than one failed component.

Testing Dual Power Trim System



22129

Dual Trim Control Panel Electrical Box

a - Relay No. 1
b - Relay No. 2
c - Diode Module
d - Terminal Block
e - Control Panel

Relay Test

TESTING RELAY NO. 1

1. Test for 12 volts at terminal 2, using only terminal 4 as a ground.

- Voltage indicated, proceed to “2.”
- No voltage indicated, replace relay.

2. Connect a jumper wire between terminals 3 and 5. Test for 12 volts at terminal 2, using only terminal 4 as a ground.

- No voltage indicated, relay OK.
- Voltage indicated, replace the relay.

TESTING RELAY NO. 2

1. Test for continuity between terminals 13 and 9.

- Continuity indicated, proceed to “2.”
- No continuity indicated, replace the relay.

2. Connect a jumper wire between terminals 3 and 5. Test for continuity between terminals 13 and 9.

- No continuity indicated, relay OK.
- Continuity indicated, replace relay.

Diode Module Test

Perform the following diode tests using an ohmmeter set on the Rx1 scale. When testing diodes, take 2 readings. Note the first reading; then, reverse the meter leads and, again, note the reading.

If the diode is good, the meter should indicate a high or infinite resistance (no meter movement) when connected one way and a low reading (below 60 ohms) when connected the other way.

If both readings are high or infinite, the diode is open. Replace the diode module.

1. **Diode No. 1**
   a. Connect a jumper wire between terminals 3 and 5. Test the diode between terminals 9 and 10.
2. **Diode No. 2**
   a. Connect a jumper between terminals 3 and 5. Test diode between terminals 10 and 13.

⚠ CAUTION

Before proceeding with further diode testing, remove fuse from red/purple harness lead so that it will not be possible to short either control box or VOA meter.

3. **Diode No. 3**
   a. Test the diode between terminals 6 and 12.
4. **Diode No. 4**
   a. Test the diode between terminals 12 and 7.

5. **Diode No. 5**
   a. Test the diode between terminals 8 and 11.
6. **Diode No. 6**
   a. Test the diode between terminals 14 and 15.
7. **Diode No. 7**
   a. Test the diode between terminals 8 and 5.
8. **Diode No. 8**
   a. Test the diode between terminals 5 and 15.

Trailer Switch Test

⚠ CAUTION

Remove fuse from RED/PURPLE harness lead before proceeding with test.

1. Set the ohmmeter on the Rx1 scale.
2. Push down on the “Trailer” switch and check for continuity between terminals 10 and 3.

- Continuity indicated, proceed to step 3.
- No continuity indicated, replace the switch.

3. Push up on the trailer switch and check for continuity between terminals 2 and 12.

- Continuity indicated, switch OK.
- No continuity indicated, replace the switch.

Starboard Trim Switch Test

1. Set ohmmeter on Rx1 scale.
2. Push down on STARBOARD TRIM switch and check for continuity between terminals 1 and 9.

- Continuity indicated, proceed to step 3.
- No continuity indicated, replace switch.

3. Push up on STARBOARD TRIM switch and check for continuity between terminals 11 and 6.

- Continuity indicated, switch OK.
- No continuity indicated, replace switch.

Port Trim Switch Test

1. Set ohmmeter on Rx1 scale.
2. Push down on PORT TRIM switch and check for continuity between terminals 2 and 13.

- Continuity indicated, proceed to step 3.
- No continuity indicted, replace switch.

3. Push up on PORT TRIM switch and check for continuity between terminals 14 and 7.

- Continuity indicated, switch OK.
- No continuity indicated, replace switch.

Dual Power Trim System Component Repair

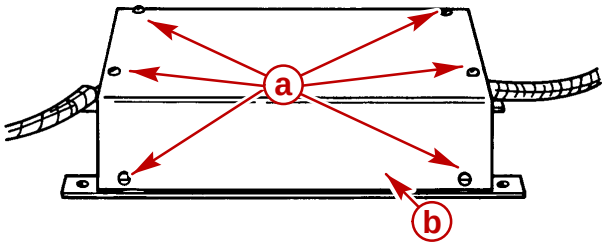
Important Information

Use care when removing and installing components. Do not force or pull wiring during replacement. Use care to prevent wiring from stretching, pinching or chafing. Coat all terminal connections with Quicksilver Liquid Neoprene.

Relay Replacement

REMOVAL

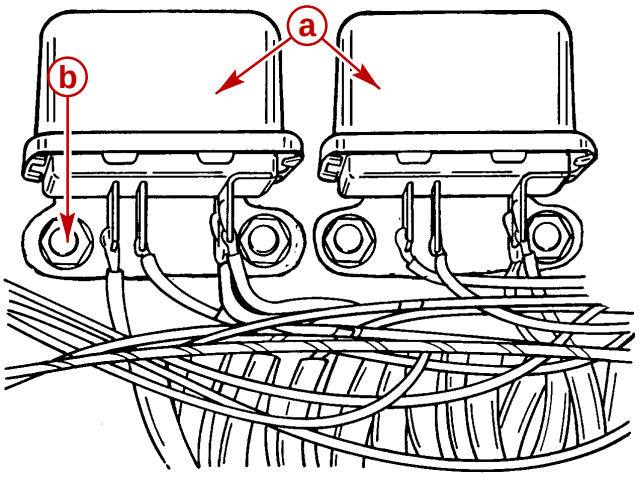
1. Remove control box cover.



22086

a - Screws
b - Cover

2. Unsolder wires from relay to be replaced.
3. Remove relay.



22086

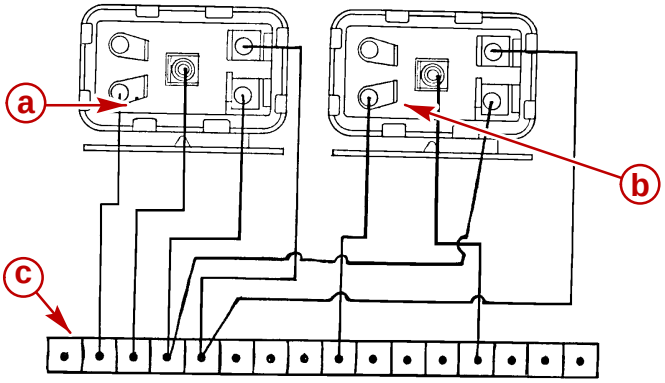
a - Relay Assemblies (1 and 2)
b - Fasteners

INSTALLATION

1. Install new relay.

IMPORTANT: Use 63/67 (Tin/Lead) alloy solder. DO NOT use acid core solder as damage to relay can result. Coat terminal connections with Quicksilver Liquid Neoprene.

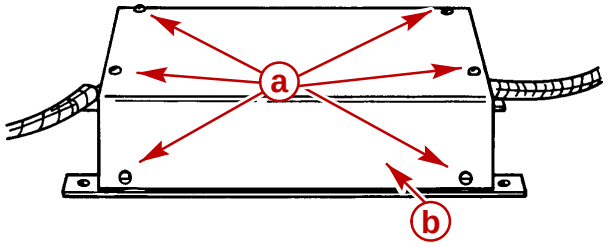
2. Resolder wires from terminal block to relay as shown.
3. Coat terminal connections with Quicksilver Liquid Neoprene.



22216

a - Relay No. 1
b - Relay No. 2
c - Terminal Block

4. Install control box cover.



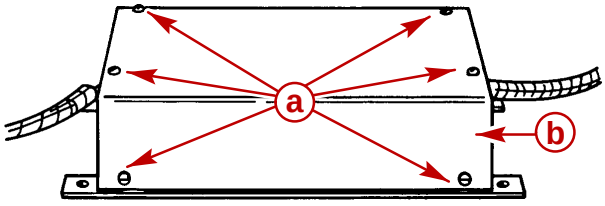
22086

a - Screws
b - Cover

Diode Module Replacement

Removal

1. Remove control box cover.



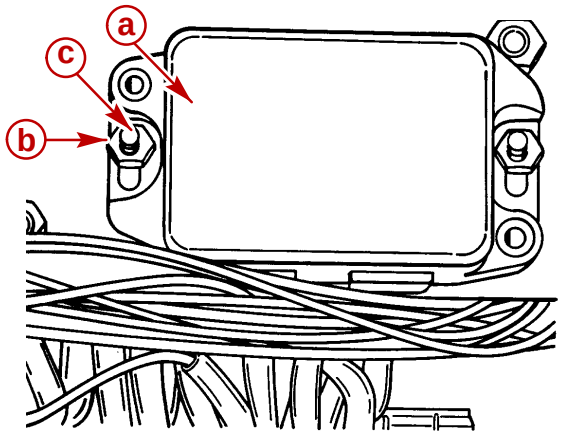
22086

a - Screws
b - Cover

2. Disconnect leads from terminal block.

Installation

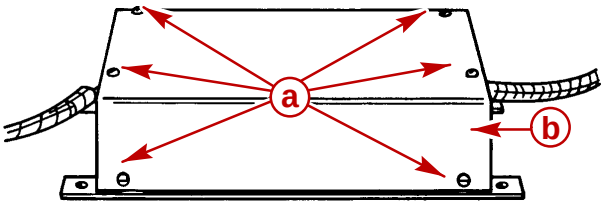
1. Replace diode module.



22086

a - Diode Module
b - Nut
c - Bolt

2. Reconnect numbered leads to respective terminals.
3. Install control box cover.



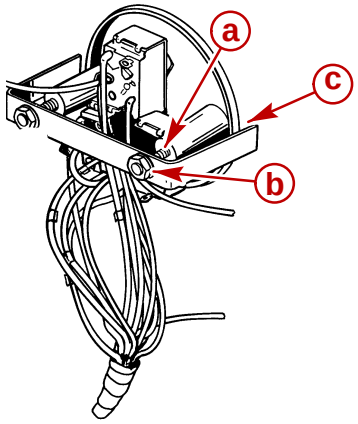
22086

a - Screws
b - Cover

Trim Control Panel Switch(es) Replacement

Removal

1. Remove trim control panel from dash.
2. Cut leads (from switch to be replaced) as close to switch terminals as possible.



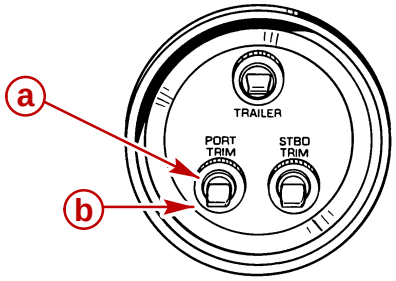
22086

a - No. 10-24 Studs
b - Flat Washers And Nuts
c - U-Bracket

3. Remove bezel nut.

Installation

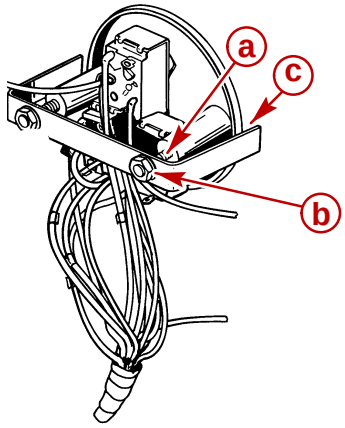
1. Replace switch.



22086

a - Bezel Nut
b - Switch

2. With new switch properly positioned in control panel, loop leads through their respective terminal eyelets. Refer to Wiring Diagram.
3. Using 60/40 (tin/lead) alloy rosin core solder, solder leads to terminals.
4. Secure trim control panel to dash.

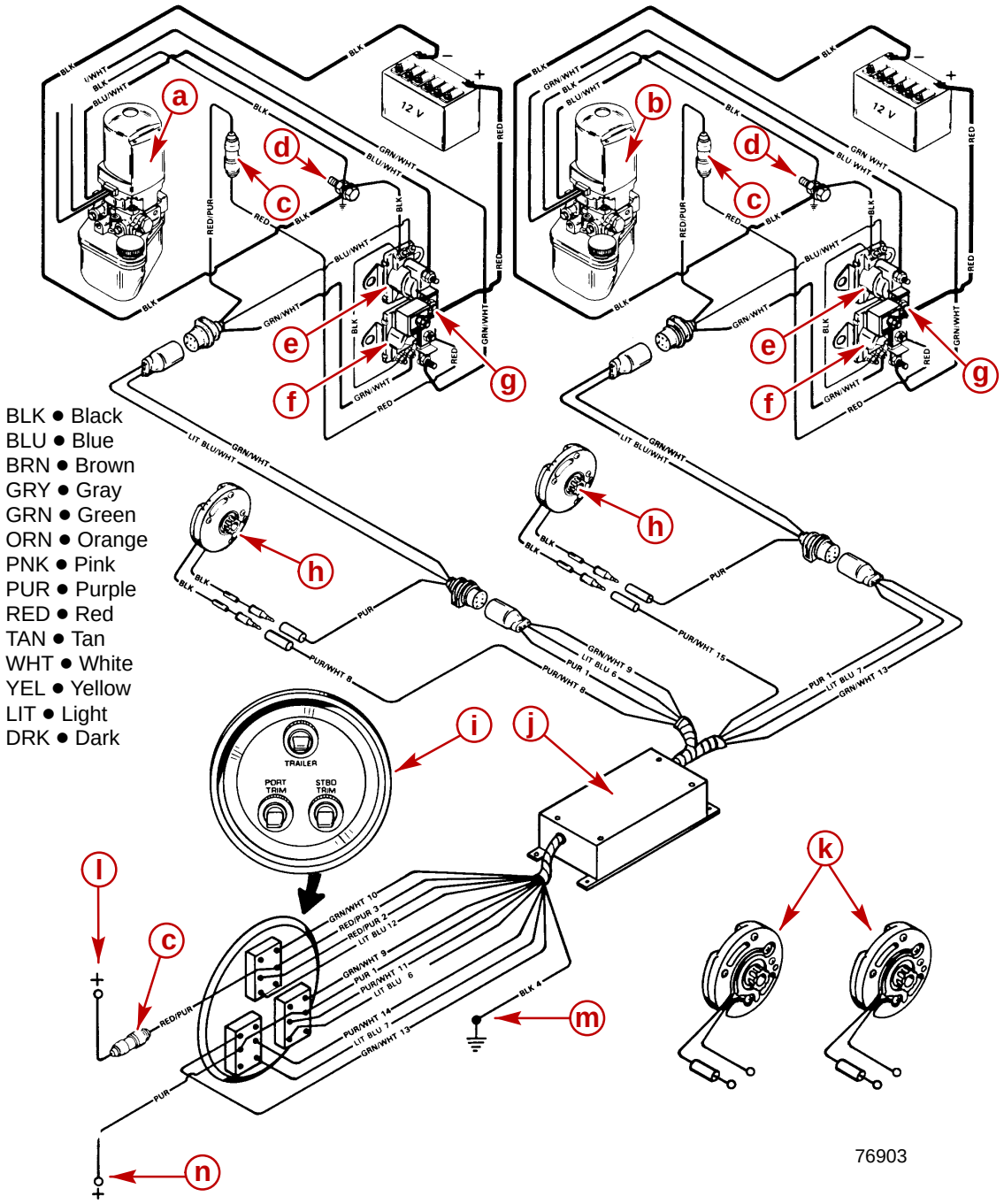


22086

a - No. 10-24 Studs
b - Flat Washers And Nuts
c - U-Bracket

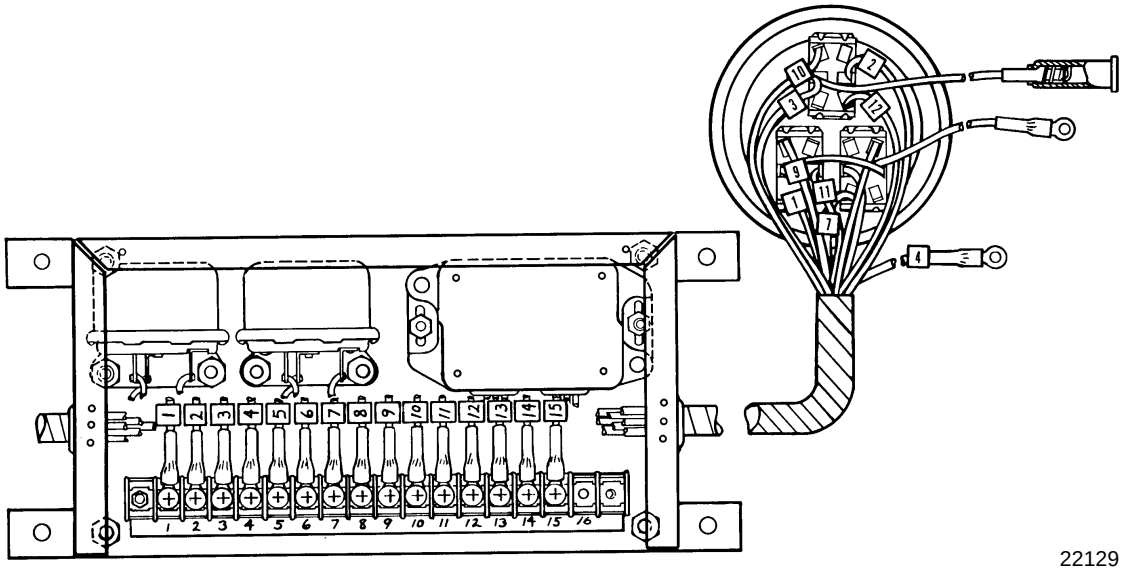
Wiring Diagrams

Dual Trim Harnesses



a - Starboard Trim Pump
b - Port Trim Pump
c - 20 Amp Fuse
d - Ground Bolt (Floor Mount)
e - UP Solenoid
f - DOWN Solenoid
g - 110 Amp Fuse
h - Trim Limit Switch
i - Trim Switch (Various Styles)
j - Control Module
k - Trim Position Sender
l - 12 Volt Power From Battery
m - Ground Wire
n - 12 Volt Power From Switched Side Of Ignition Switch

Electrical Box Wiring



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POWER TRIM

Section 5D - Auto Trim II

Table of Contents

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Description	5D-2	Adjusting Sterndrive Unit Trim Angle	5D-7
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5 D

Auto Trim II System

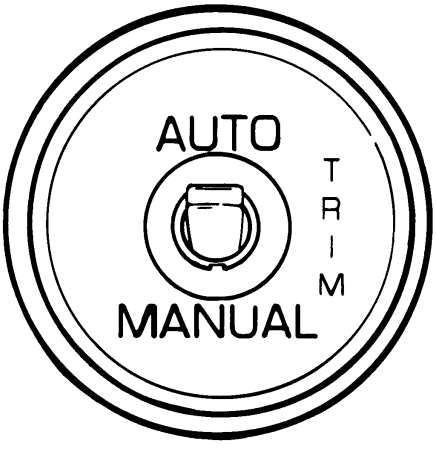
Description

The Auto Trim System consists of the following major components:

- Auto Trim Pump - same pump that is used on the standard power trim models.
- Control Module - a solid-state electronic device that senses engine rpm and regulates the time at which the sterndrive unit trims IN and OUT when operating in the AUTO mode. Module is protected by a 20-amp fuse.
- Mode Switch - allows the operator to select either AUTO or MANUAL trim operation from the dash.
- Manual Trim Control - will only function with mode switch in the MANUAL mode and ignition switch in the RUN position. Allows the operator to raise and lower the sterndrive unit for trailering, beaching, launching and shallow water operation. Also, allows the operator to manually adjust the sterndrive unit trim angle while underway in situations where automatic trimming is not desired (rough seas, etc.).
- Trim Limit Switch - Establishes the maximum trim OUT limit in both the MANUAL and AUTO mode. Prevents sterndrive unit from moving out of the gimbal ring support flanges, which could cause possible damage to sterndrive if it were to occur at higher engine speeds.

Auto Trim II Operation

The Auto Trim system is designed to allow either automatic or manual trimming of the boat while underway - in addition to allowing sterndrive unit to be raised for trailering, beaching, launching or shallow water operation. A 2-position switch on dashboard allows the operator to select the mode desired.



22217

Auto Mode Operation

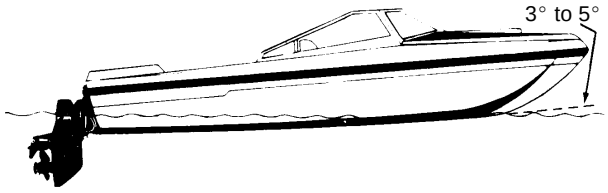
⚠ WARNING

Sterndrive unit will automatically lower from the raised position when the ignition switch is turned to the RUN position and mode switch is placed in the AUTO mode. BE SURE THAT NO ONE IS IN THE AREA OF THE STERNDRIVE UNIT.

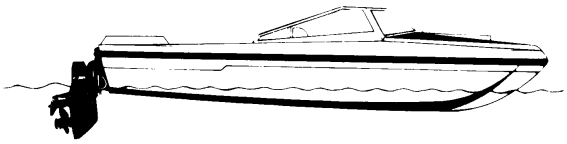
With mode switch in the AUTO mode, the sterndrive unit will move automatically to properly trim the boat while underway. This allows boat operator to keep both hands on the steering wheel and to direct operator's full attention to driving the boat.

- At engine speeds below 3100 rpm, the sterndrive unit will remain in the full IN position. This will force the bow of the boat down and help it get up on plane quickly.
- Once engine reaches 3100 rpm and after a 5-6 second delay (to ensure that boat is up on plane), the sterndrive unit will automatically trim OUT to a preset position for maximum boat speed and efficiency. Trim OUT position can be adjusted to fine tune the trim angle for each individual boat.
- Upon deceleration, the sterndrive unit will trim IN when engine reaches 2600 rpm. Most boats will still be up on plane at this point. After sterndrive reaches full IN position, the trim pump motor will continue to run for approximately 5 seconds.

NOTE: *The AUTO mode also can be used to lower the sterndrive unit from the fully raised (trailering) position. By placing ignition switch in RUN position and mode switch in AUTO mode, the sterndrive unit will automatically lower to the full IN position. Be sure that no one is in the area of the sterndrive unit.*



Boat Running Above Planing Speed



Boat Running Below Planing Speed

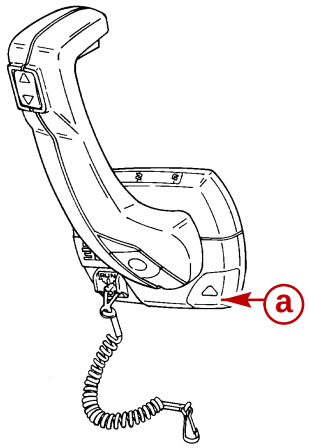
“Manual” Mode Operation

Placing the mode switch in the MANUAL position will deactivate the AUTO system and allow the operator to adjust sterndrive unit position, using the manual trim control. Typical controls are shown following. Manual trimming may be desirable to fine tune the trim angle for a particular water condition or boat load, or in situations where greater control over the trim operation is needed.

Manual trim control also must be used to raise the sterndrive unit for trailering, beaching, launching and shallow water operation. Ignition switch must be in the RUN position for manual trim control to function.

RAISING STERNDRIVE UNIT TO TRAILER POSITION

1. Press the trailer button until sterndrive unit reaches desired height or end of upward travel.



22174

a - Trailer Button

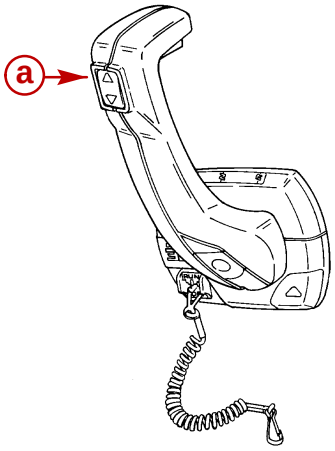
NOTE: *Some power trim pump motors are protected from overheating by an internal circuit breaker. If trailering switch(es) are held depressed after sterndrive unit reaches end of upward travel, internal circuit breaker will open and pump will stop. If this should happen, release switch(es) and allow motor to cool for approximately 2 minutes. Once motor is cool, circuit breaker will reset automatically, and trim operation may be resumed.*

⚠ CAUTION

DO NOT run engine above idle rpm with unit raised for shallow water operation, as sterndrive unit is out beyond gimbal ring support flanges and has no side support. USE EXTREME CAUTION WHEN OPERATING BOAT WITH STERNDRIVE UNIT RAISED.

TRIMMING STERNDRIVE UNIT OUT (BOW UP)

1. Press UP/OUT Button until sterndrive unit moves to properly trim boat or trim limit switch stops outward travel.



22174

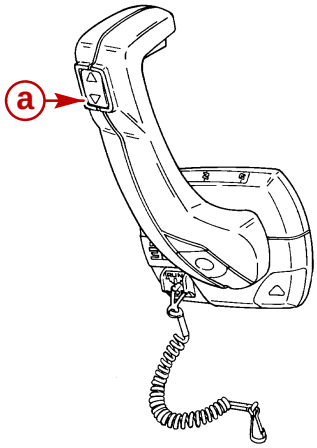
a - UP/OUT Button

⚠ CAUTION

NEVER trim the sterndrive unit OUT using the "Trailer" switch(es) while boat is underway. Severe damage to sterndrive unit may result if the unit is raised beyond the gimbal ring support flanges at engine speeds above idle RPM.

TRIMMING STERNDRIVE UNIT IN (BOW DOWN)

1. Press IN/DOWN Button until sterndrive unit moves to properly trim boat or until sterndrive unit reaches end of downward travel.



70023

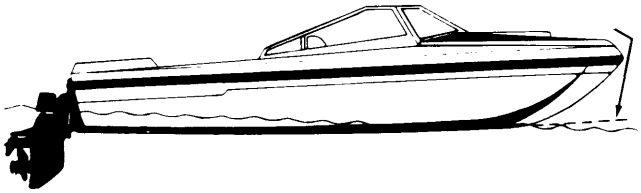
a - IN/DOWN Button

Electrical System Overload Protection

The Auto Trim electrical system is protected from overload by a 110-amp fuse, and a 20-amp in-line fuse at control module positive (+) battery lead and a 20-amp in-line fuse at ignition switch (if Quicksilver ignition switch is used). If boat is equipped with 3-Button Control Panel, a 20-amp in-line fuse also is located at panel. If Auto Trim electrical system becomes inoperative, check for a blown fuse. If fuse has blown, the cause for overload MUST BE found and corrected BEFORE replacing fuse.

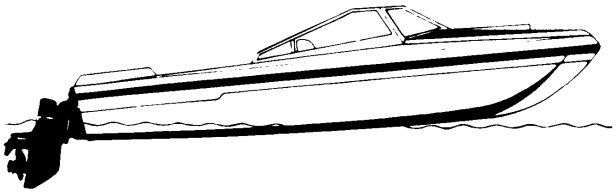
Auto Trim Limit Adjustment

In most cases, best all-around performance is obtained with sterndrive unit adjusted so that front of hull will be slightly out of water when boat is on plane.



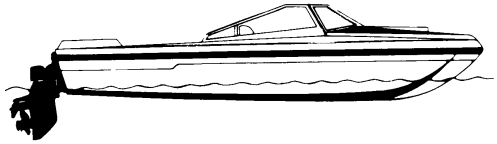
Boat Properly Trimmed

Adjusting the sterndrive unit OUT from this position will tend to raise the bow of the boat, reducing the wetted surface of the hull and, in some cases, increasing boat speed. If trimmed out excessively, bouncing, porpoising, propeller ventilation and possible difficult steering control could result.



Bow Too High - Move Sterndrive Unit IN

Adjusting the sterndrive unit IN from normal position will force the bow of the boat down, increasing the wetted surface of the hull and, in some cases, improving boat ride in rough water (at partial throttle). However, this will reduce boat speed.



Bow Too Low - Move Sterndrive Unit OUT

Adjusting Sterndrive Unit Trim Angle

⚠ WARNING

When adjusting trim limit use extreme care that engine is not accidentally started and keep clear of area near propeller. Also, use care to prevent placing hands in an area where they could be injured by sterndrive unit movement.

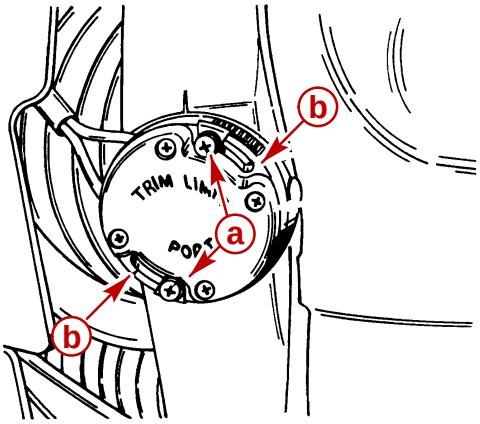
⚠ CAUTION

Trim limit switch MUST BE adjusted exactly as stated following. If switch is adjusted incorrectly, sterndrive unit may move out beyond the gimbal ring support flanges and severe damage to sterndrive unit may result.

If more trim OUT capability is desired, perform the following.

DRY DOCK PROCEDURE

1. Place sterndrive unit in the full IN/DOWN position.
2. Loosen trim limit switch retaining screws.
3. Turn trim limit switch clockwise to end of adjusting slots.

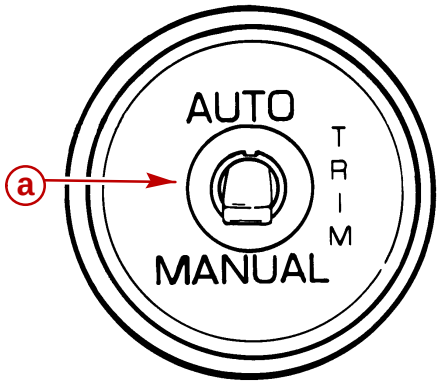


71221

Trim Limit Switch

a - Retaining Screws
b - Adjusting Slots

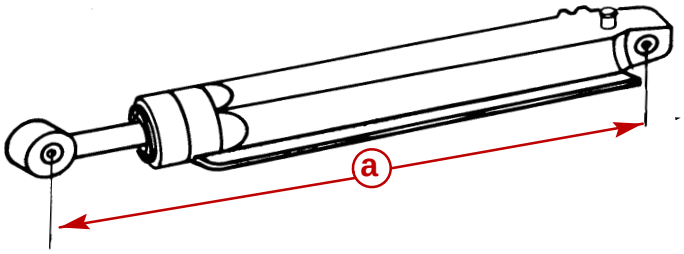
4. Place auto trim mode switch in the MANUAL mode.
5. Turn ignition key to the RUN position.



76848

Auto Trim Mode Switch

6. With the assistance of another person actuate manual trim control switch used to trim sterndrive unit OUT (DO NOT use “Trailer” switch) and turn trim limit switch SLOWLY counterclockwise until trim cylinders extend to dimension shown. Retighten trim limit switch retaining screws.



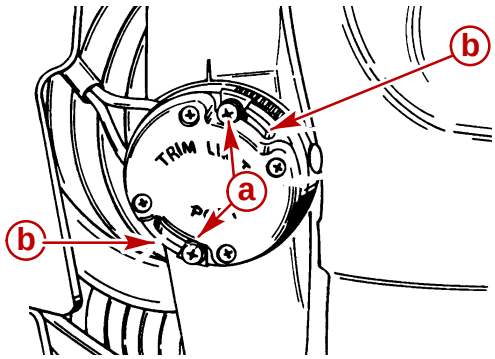
70136

a - Trim Limit Dimension 20-3/4in. (520 mm)

7. Turn ignition key OFF.

ON-WATER PROCEDURE

1. Run boat along a relatively smooth stretch of water and trim boat with manual trim control until optimum boat performance is achieved.
2. After finding trim angle that provides best performance, stop engine (without changing sterndrive unit trim angle). Accurately measure distance between trim cylinder end cap and pivot end.
3. Place sterndrive unit in the full IN position.
4. Loosen trim limit switch retaining screws.
5. Turn trim limit switch clockwise to end of adjusting slots.



71221

Trim Limit Switch

a - Retaining Screws
b - Adjusting Slots

6. Leaving auto trim mode switch in the MANUAL mode, turn ignition key to RUN position.
7. With the assistance of another person, actuate manual trim control switch used to trim sterndrive unit OUT and turn trim limit switch SLOWLY counterclockwise until trim cylinders extend to dimension recorded in STEP 2. Tighten switch retaining screws securely.

8. Run boat with auto trim mode switch in AUTO position at several speeds, through turns under various water and load conditions, if boat does not perform to satisfaction, repeat adjusting procedure.

⚠ WARNING

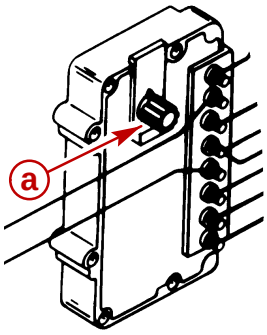
Difficulties in handling and operational control may result if sterndrive unit is adjusted OUT too far. If difficulties are encountered, sterndrive unit trim angle MUST BE moved IN the amount necessary to eliminate the problem and avoid a possible safety hazard.

Control Module Adjustment

1. Completely turn adjustment knob on control module COUNTERCLOCKWISE.
2. Turn knob back CLOCKWISE four clicks.
3. With auto trim mode switch in AUTO position and the sterndrive unit trimmed full IN/DOWN, accelerate boat slowly while watching trim gauge.
4. If boat is on plane well before sterndrive unit begins to trim out (this may happen with lighter, faster boats), rotate adjustment knob COUNTERCLOCKWISE one click and accelerate boat slowly.

Continue procedure until boat is on plane approximately five or six seconds before trim out occurs.

5. If boat is not on plane before sterndrive unit begins to trim out (this may happen with slower, heavier boats), rotate adjustment knob clockwise one click and accelerate boat slowly.



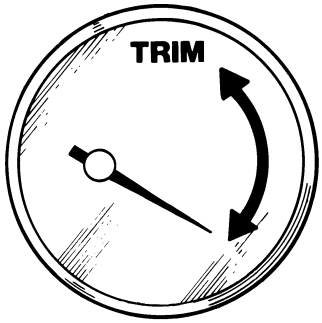
22178

Control Module

a - Adjustment Knob

Trim Position Indicator Adjustment

With ignition key in the RUN position, check Auto Trim indicator to make sure that needle points to bottom of the scale when sterndrive unit is IN/DOWN. If needle is not at bottom of scale, perform following steps:



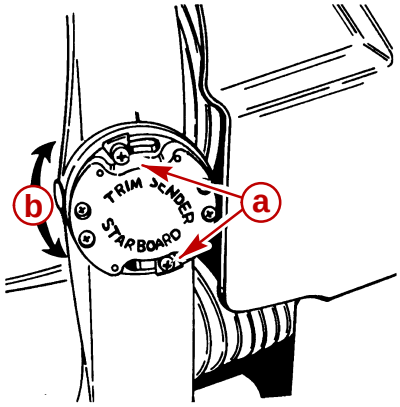
22175

Trim Position Indicator

⚠ WARNING

While performing this adjustment, use extreme care that engine is not accidentally started; keep clear of the area near propeller.

1. Turn ignition key to RUN position.
2. Loosen trim position sender retaining screws.
3. Rotate sender to position indicator needle at bottom of the scale.
4. Retighten retaining screws securely.
5. Recheck trim position indicator reading and turn ignition key to OFF position.



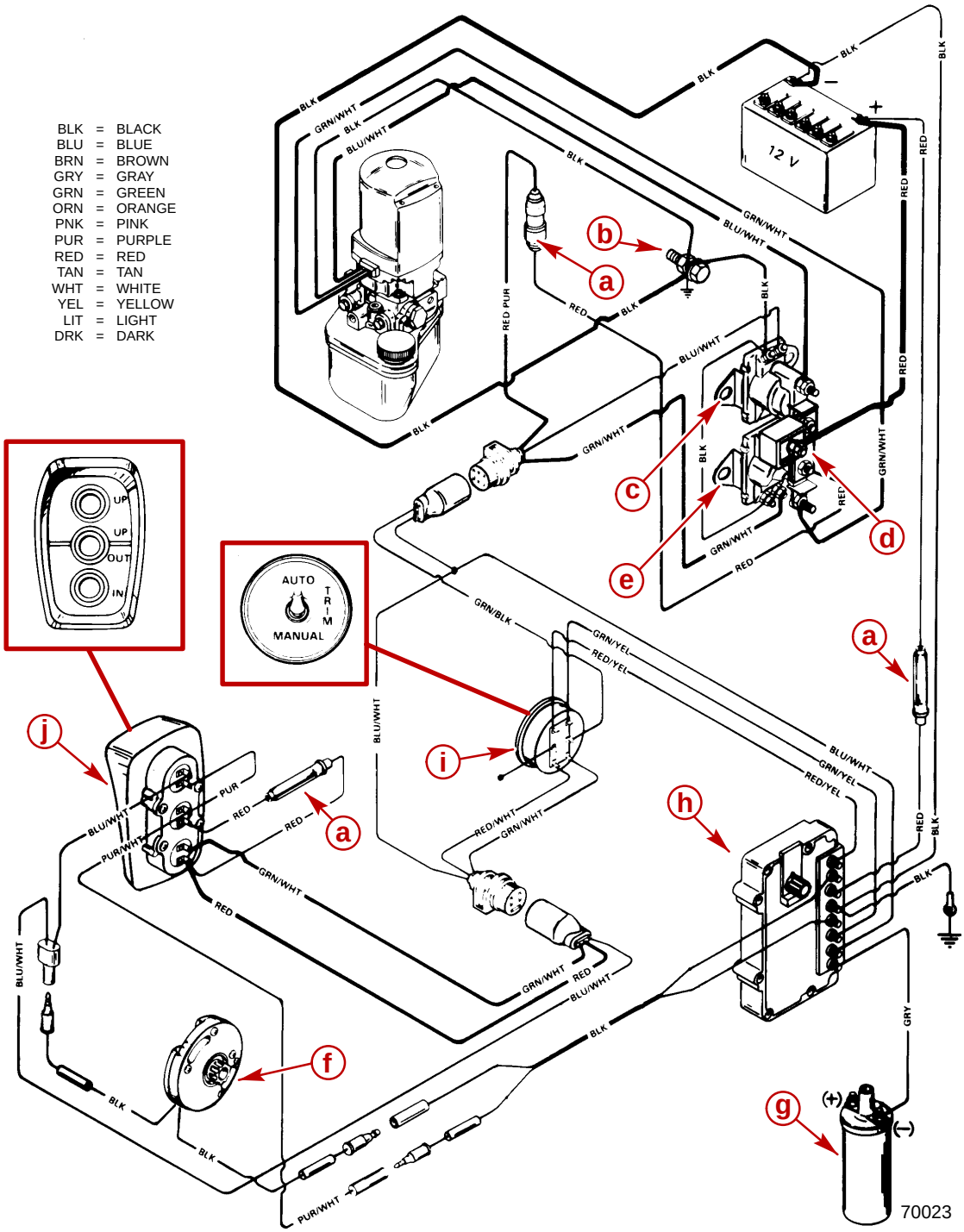
71220

Trim Sender Switch

a - Retaining Screws
b - Adjustment

Wiring Diagram

BLK = BLACK
BLU = BLUE
BRN = BROWN
GRY = GRAY
GRN = GREEN
ORN = ORANGE
PNK = PINK
PUR = PURPLE
RED = RED
TAN = TAN
WHT = WHITE
YEL = YELLOW
LIT = LIGHT
DRK = DARK



a - 20 Amp Fuse
b - Ground Bolt (Floor Mount)
c - UP Solenoid
d - 110 Amp Fuse
e - DOWN Solenoid
f - Trim Limit Switch
g - Ignition Coil
h - Control Module
i - Auto/Manual Switch
j - Trim Switches (Various Styles)

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STEERING SYSTEMS

Section 6A - Power Steering

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6 A

Specifications

Special Tools

Kent-Moore Special Tools	
Kent-Moore Tools, Inc. 29784 Little Mack Roseville, MI 48066 Phone: (313) 774-9500	
Power Steering Pump Pulley Remover	J-25034

Snap-On Special Tools	
Snap-On Tools 2801 80th Street Kenosha, WI 53141 See Snap-On Catalog for your regional distributor phone number.	
Serpentine Belt Pulley Remover	CJ124A

MerCruiser Special Tools	
Mercury Marine W6250 Pioneer Rd., P.O. Box 1939 Fond Du Lac, WI 54936-1939 Phone: 1-800-487-MERC Fax: 1-800-457-8736 www.MERCURYMARINE.COM	
Power Steering Test Gauge	91-38053A4
Power Steering Pump Pulley Installer	91-93656A1

Lubricants/Adhesives/Sealers

Description	Part No.
2-4-C Marine Lubricant with Teflon	92-825407A12
Special Lubricant 101	92-13872A1
Loctite No. 8831	92-826089-1

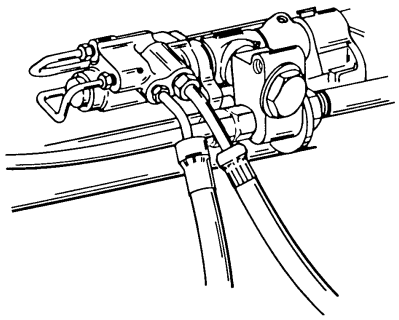
Description

The Power Steering system utilizes an engine-driven, vane-type hydraulic pump that supplies fluid flow and pressure by means of hoses to a control valve that, in turn, controls fluid flow and pressure to-and-from a booster cylinder. Three modes make up the basic function of the Power Steering system: 1) neutral mode, 2) left turn mode, and 3) right turn mode. The control valve, which is activated by the steering cable, controls the steering system modes.

NOTE: *The following Power Steering unit installations are viewed from inside boat, looking at transom.*

Earlier Style Control Valve

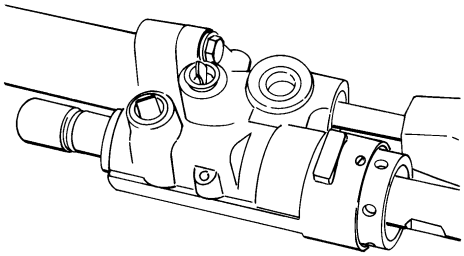
Most illustrations in this section show an earlier style power steering control valve. This valve has various components that can be replaced and or serviced.



50912

Later Style Control Valve

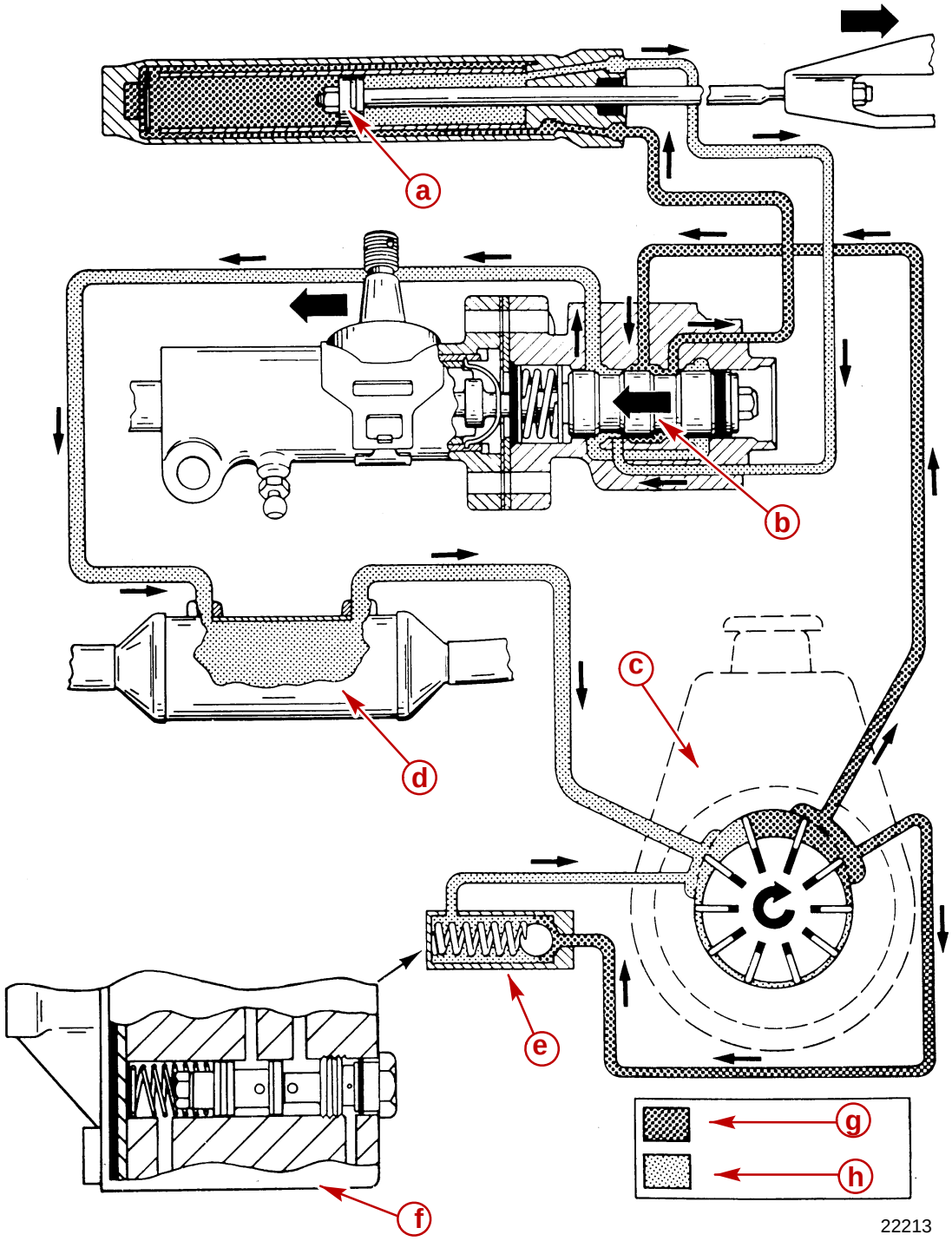
The later style control valve is not serviceable and must be replaced as a complete assembly.



73898

Earlier Model Power Steering System

Right Turn

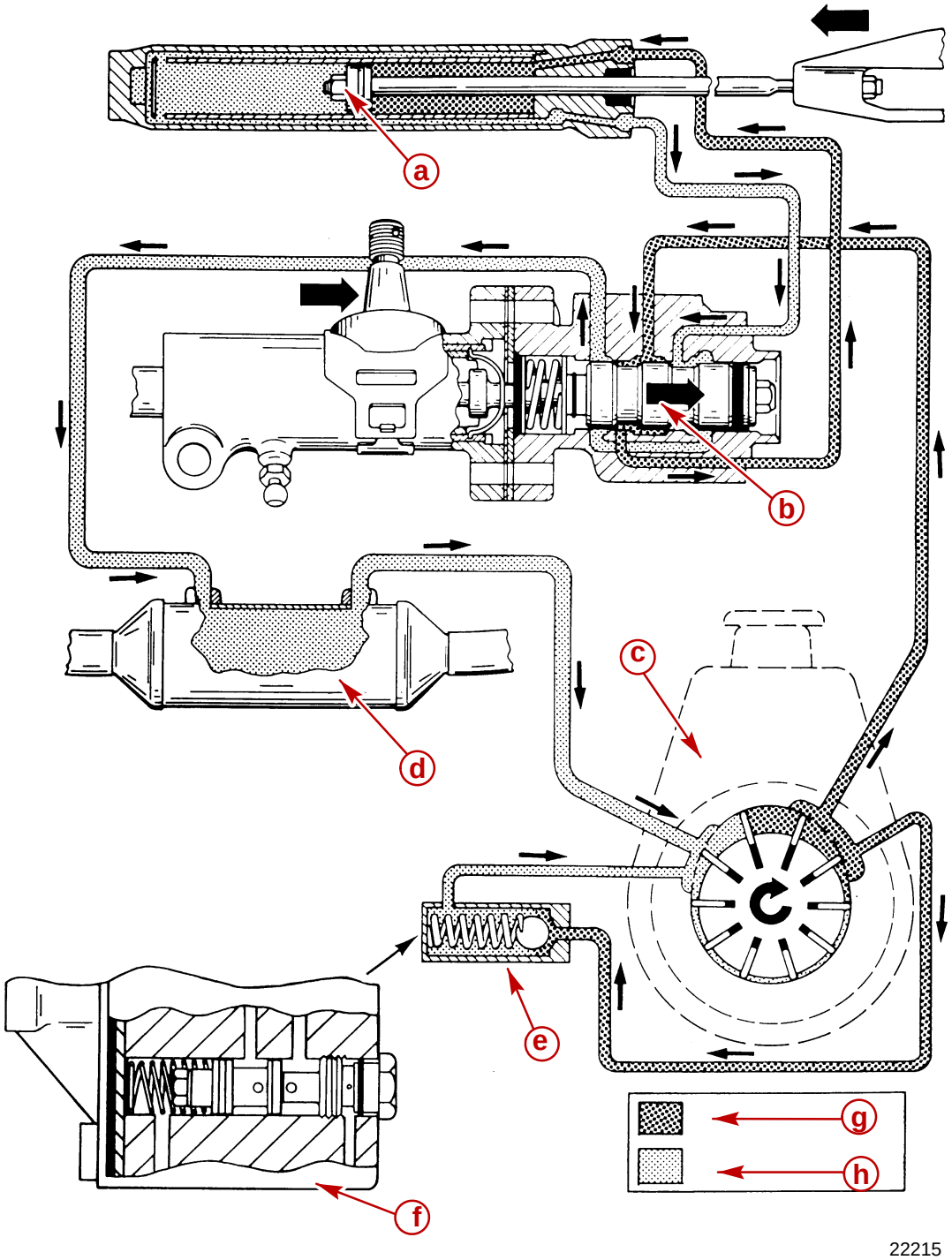


(VIEWING FROM INSIDE OF BOAT LOOKING AT TRANSOM)

a - Piston
b - Control Valve
c - Pump
d - Power Steering Fluid Cooler
e - Relief Valve
f - Pump Housing
g - High Pressure
h - Low Pressure

Earlier Model Power Steering System

Left Turn



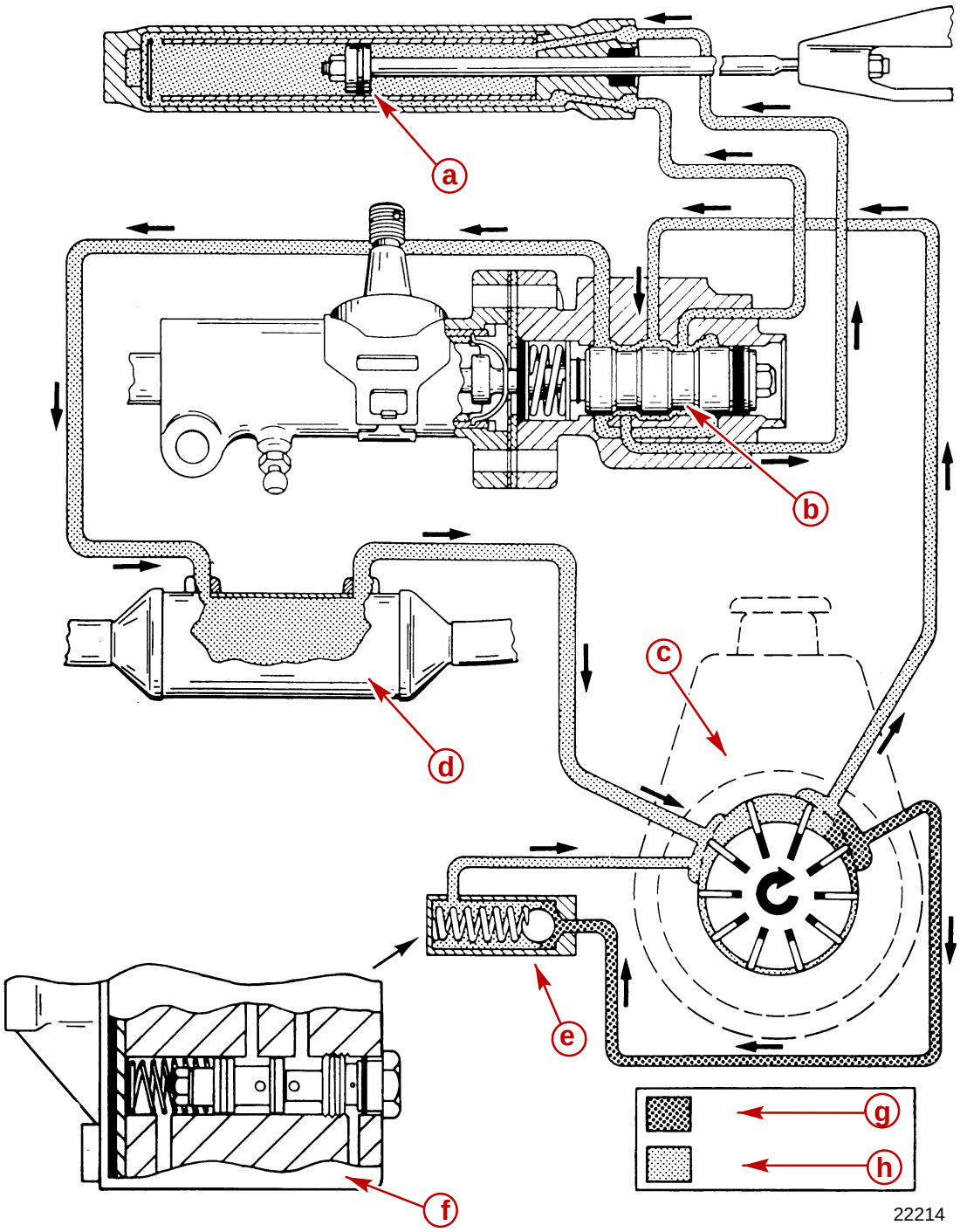
22215

(VIEWING FROM INSIDE OF BOAT LOOKING AT TRANSOM)

a - Piston
b - Control Valve
c - Pump
d - Power Steering Fluid Cooler
e - Relief Valve
f - Pump Housing
g - High Pressure
h - Low Pressure

Earlier Model Power Steering System

Neutral

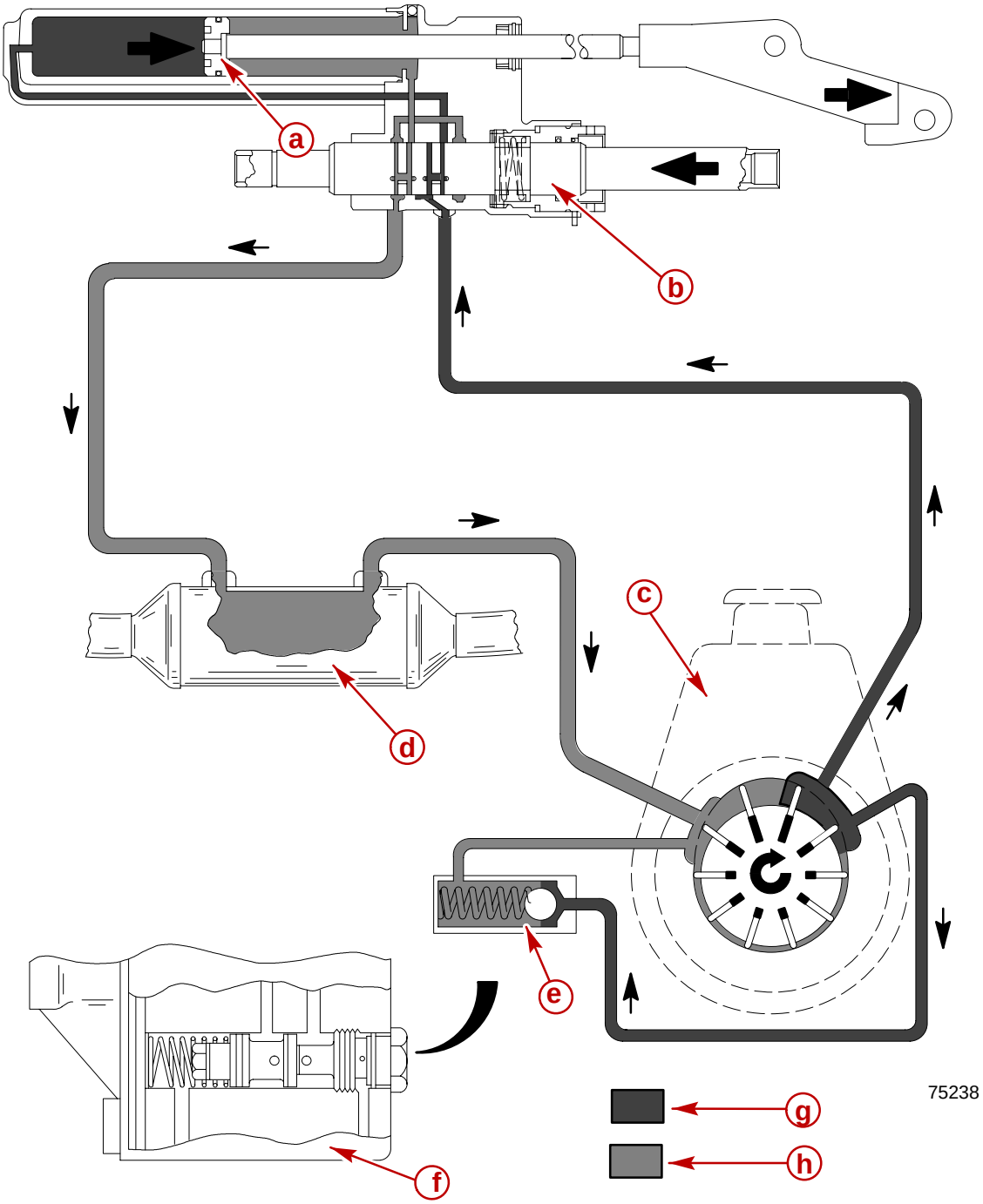


(VIEWING FROM INSIDE OF BOAT LOOKING AT TRANSOM)

a - Piston
b - Control Valve
c - Pump
d - Power Steering Fluid Cooler
e - Relief Valve
f - Pump Housing
g - High Pressure
h - Low Pressure

Later Model Power Steering System

Right Turn

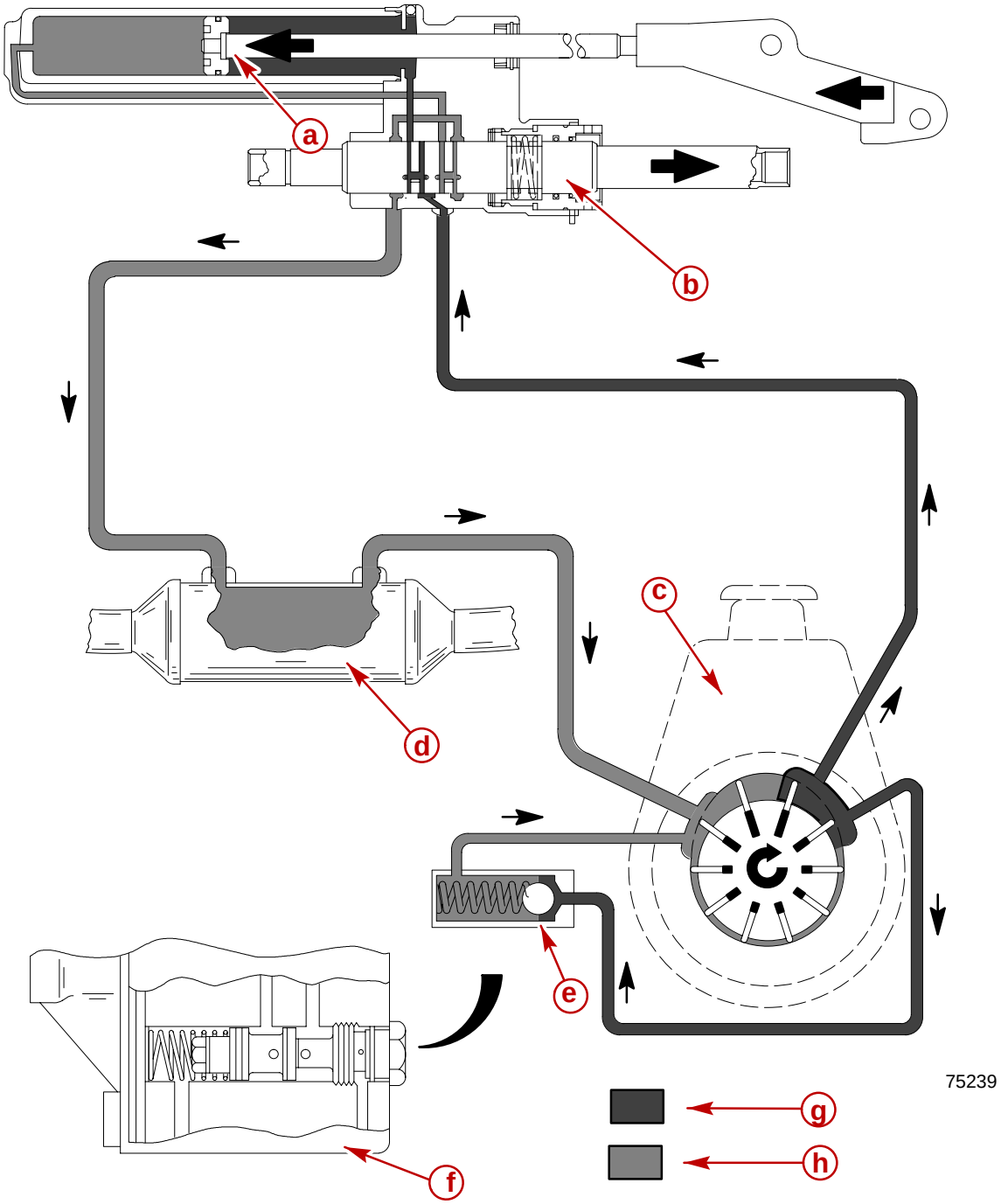


(VIEWING FROM INSIDE OF BOAT LOOKING AT TRANSOM)

a - Piston
b - Control Valve
c - Pump
d - Power Steering Fluid Cooler
e - Relief Valve
f - Pump Housing
g - High Pressure
h - Low Pressure

Later Model Power Steering System

Left Turn

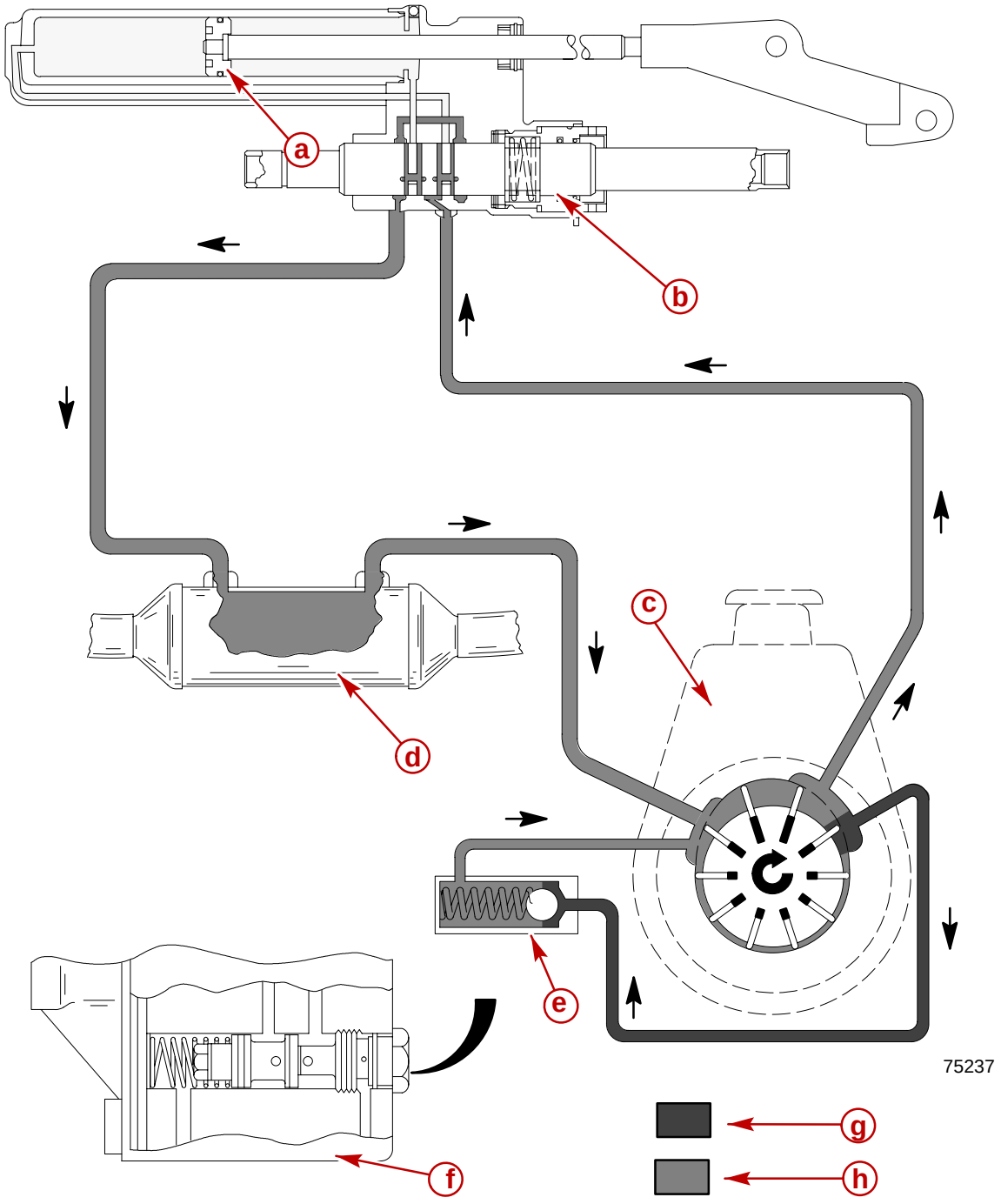


(VIEWING FROM INSIDE OF BOAT LOOKING AT TRANSOM)

a - Piston
b - Control Valve
c - Pump
d - Power Steering Fluid Cooler
e - Relief Valve
f - Pump Housing
g - High Pressure
h - Low Pressure

Later Model Power Steering System

Neutral



(VIEWING FROM INSIDE OF BOAT LOOKING AT TRANSOM)

a - Piston
b - Control Valve
c - Pump
d - Power Steering Fluid Cooler
e - Relief Valve
f - Pump Housing
g - High Pressure
h - Low Pressure

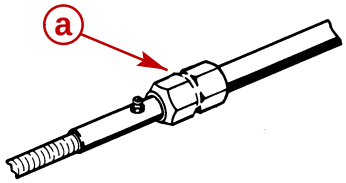
Steering Helm and Cable

Transom assembly is shipped with the steering cable guide tube preset for cables with end dimensions that comply with ABYC standards as outlined in the NMMA certification handbook. The steering cable coupler nut must also have a means of locking it to the guide tube, as specified in ABYC requirements.

⚠ WARNING

Failure to use a steering cable locking device could cause loss of steering, which could cause damage to the boat and/or injury.

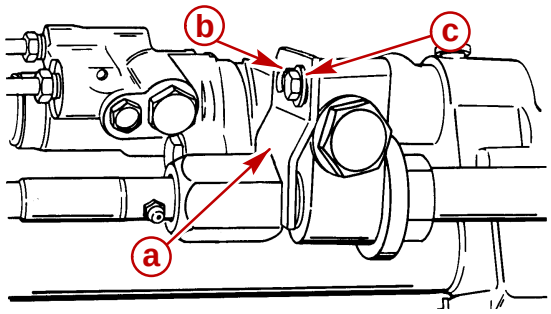
All current production Quicksilver Ride Guide steering cables have a self-locking coupler nut and do not require an external locking device. (Other cable manufacturers also make cables with self-locking coupler nut.)



22060

a - Quicksilver Ride Guide Steering Cable Self-Locking Coupler Nut (Identified By Groove)

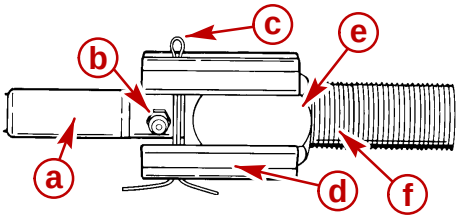
IMPORTANT: If using a steering cable that does not have a self-locking coupler nut, an external locking device must be used.



50629

Locking Plate

a - Locking Plate P/N 92766
b - Screw P/N 10-41209 - (see “Torque Specifications”)
c - Washer P/N 12-35462



Locking Sleeve

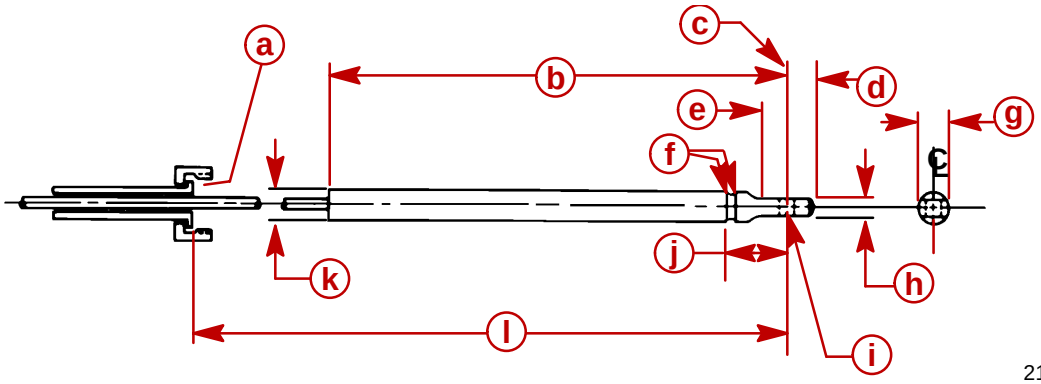
a - Steering Cable
b - Grease Fitting
c - Cotter Pin
d - Locking Sleeve (If Required - Must Be Ordered Separately)
e - Cable Coupler Nut
f - Cable Guide Tube

⚠ CAUTION

POWER STEERING EQUIPPED UNITS ONLY - If cables with improper dimensions are installed, severe damage to transom assembly and/or steering system may result. DO NOT attempt to adjust cable guide tube on power steering unit, as guide tube and locknut have been torqued (with Loctite) at the factory, and an attempt to loosen nut or sleeve may result in damage to tube.

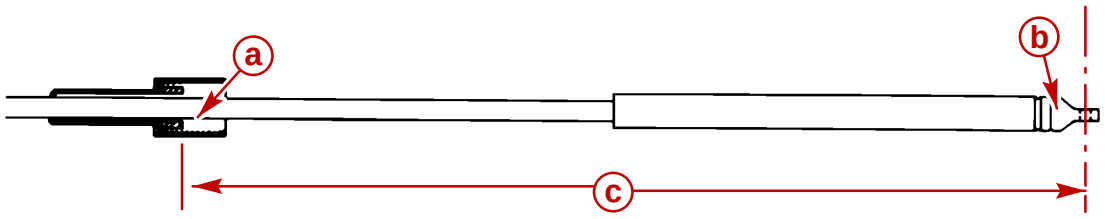
1. Steering cable must be the correct length, particularly when installed in larger boats.
2. Avoid sharp bends, kinks or loops in cable.
3. **Power Steering Models:** Fully extended steering cable end dimension must be correct.

Steering Cable Specifications



21435

a - Coupler Nut - 7/8 - 14 UNF - 2B Thread
b - 11-3/4 in. (298 mm) Min.
c - Interface Point
d - 1/2 in. (12.7 mm) Max.
e - .420 in. (10.668 mm) Min. Flat
f - .102 in. (0.508 mm) Min. Radius
g - 5/8 in. (15.875 mm) Max. Diameter End Fitting
h - 3/8 in. (9.525 mm)
i - .385 in. (9.779 mm) Diameter Through Hole, Chamfered Each Side
j - 1-3/8 in. (34.925 mm) Max.
k - 5/8 in. (15.875 mm) Diameter Tube
l - Mid-Travel Position - 16-7/8 in. (428.6 mm). Total Travel To Be 8 in. (203.2 mm) Min., to 9 in. (228.6 mm) Max. Travel Each Side of Mid-Travel Position - 4 in. (101.6 mm) Min., 4-1/2 in. (114.3 mm) Max.

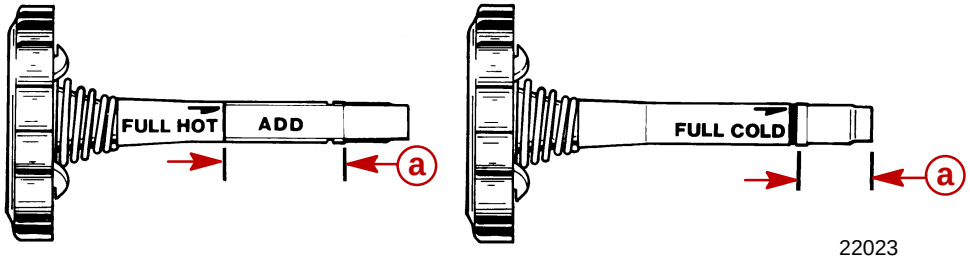


a - Steering Cable Mounting Flange
b - Center of Hole in Steering Cable End
c - 21-3/8 in. (543 mm) Maximum

Filling and Air Bleeding Power Steering System

IMPORTANT: Power Steering system MUST BE filled exactly as explained, following, to be sure that all air is bled from the system. All air must be removed, or fluid in pump may foam during operation and be discharged from pump reservoir. Foamy fluid also may cause Power Steering system to become spongy, which may result in poor boat control.

1. Position drive unit straight back. Remove fill cap from power steering pump and check fluid level with dipstick.
2. Add Quicksilver Power Trim and Steering Fluid or Dexron II, as required, to bring fluid up to correct level.



Engine Warm from Operation **Engine Cold**

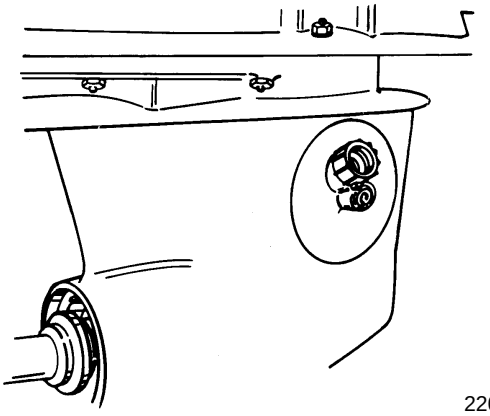
a - Recommended Fluid Level

3. (With engine not running), turn the steering wheel at a moderate rate, back-and-forth, to end of travel in each direction, pausing each time at end of travel for a few seconds to allow any air to bubble from pump reservoir. Do this a minimum of 5 complete cycles. Recheck fluid level and add if necessary.
4. Reinstall fill cap.

⚠ CAUTION

DO NOT operate engine without water being supplied to seawater pickup holes in gear housing. Overheating damage to engine may result.

5. Install flush test device and connect a hose between it and water tap.



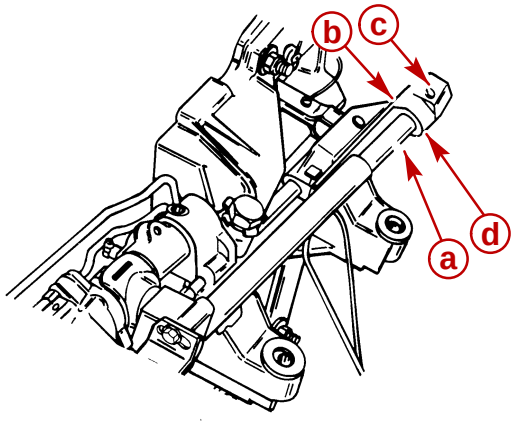
NOTE: *If using a test tank or if boat is in the water, ensure sterndrive unit gear housing water intake holes are below water level.*

6. Partially open water tap (approximately 1/2 max.) and allow water to enter cooling system. DO NOT use full water tap pressure.
7. Start engine and run at idle. During this time, turn steering wheel back-and-forth to end of travel in each direction several times.
8. Position drive unit so that it is straight back and then stop engine. Remove fill cap from pump. Allow any foam in pump reservoir to disperse, then check fluid level and add fluid, if needed. DO NOT OVERFILL. Reinstall fill cap and tighten securely.
9. If fluid was foamy in previous step, repeat steps 7 and 8 until fluid does not foam and level remains constant.

Balancing Power Steering Control Valve

IMPORTANT: Control valve is balanced by the manufacturer and should not require further adjustment. However, if drive unit tends to creep in one direction or the other (with engine running, drive unit in neutral, and hands off the steering wheel), the control valve MUST BE balanced as explained following.

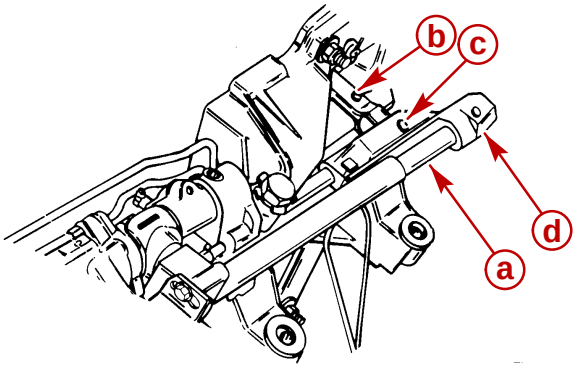
1. Ensure engine is off.
2. Disconnect steering cable from power steering control valve clevis.



22023

a - Steering Cable
b - Clevis
c - Pin
d - Cotter Pin

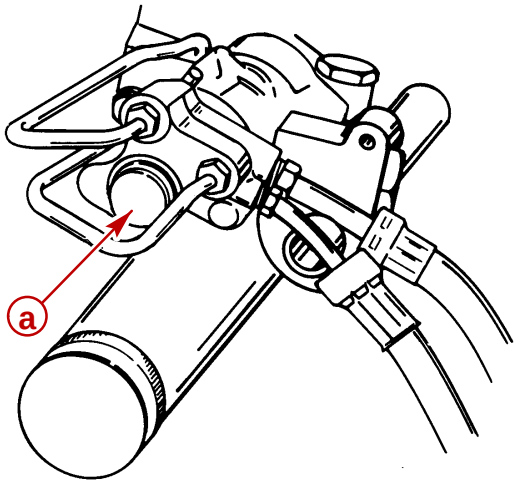
3. Disconnect power steering control valve clevis from drive unit steering lever.



22023

a - Clevis
b - Steering Lever
c - Pin
d - Cotter Pin (Hidden)

4. Remove dust cover.



22023

a - Dust Cover

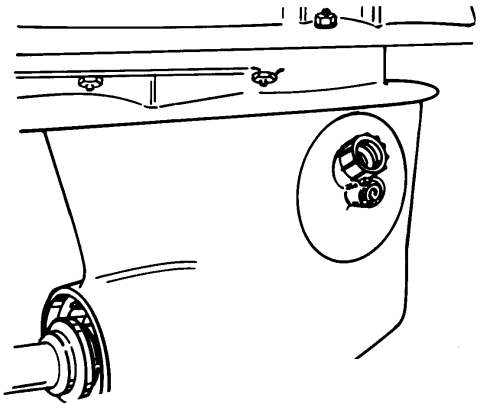
⚠ CAUTION

DO NOT operate engine without water being supplied to seawater pickup holes in gear housing. Water pump damage and overheating damage to engine may result.

⚠ WARNING

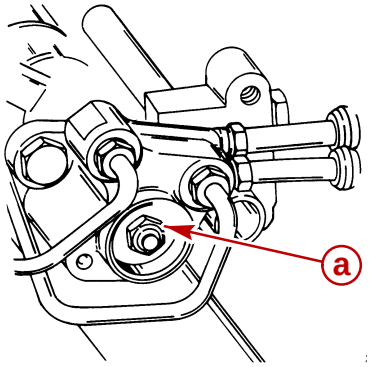
Remain clear of power steering clevis when starting engine. If control valve is not balanced, unexpected movement of clevis could cause injury.

5. Connect a flush test device to drive unit. Partially open water tap (approximately 1/2 max.) and allow water to enter cooling system. DO NOT use full water tap pressure.



22029

6. Start engine and adjust control valve by turning adjustment nut as follows:



22023

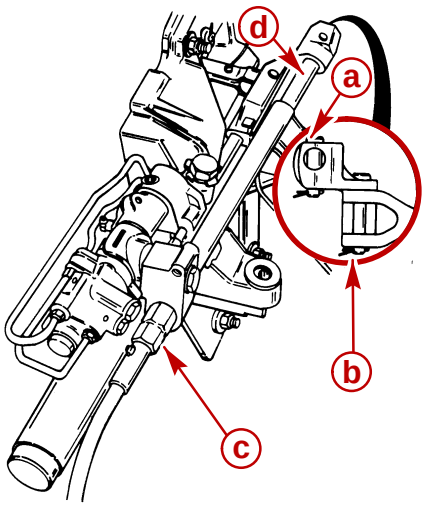
a - Adjustment Nut

   a. **If power steering piston rod end clevis moves toward right (starboard),** turn nut clockwise until clevis just begins to move toward left (port), then turn nut counterclockwise until clevis just begins to move toward right (starboard). Turn nut clockwise to exactly 1/2 the rotation necessary to change direction of rod end clevis movement.

   b. **If power steering piston rod end clevis moves toward left (port),** turn nut counterclockwise until clevis just begins to move toward right (starboard), then turn nut clockwise until clevis just begins to move toward left (port). Turn nut counterclockwise to exactly 1/2 the rotation necessary to change direction of rod end clevis movement.

7. Turn off engine.
8. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
9. Torque self-locking coupler nut to 35 lb-ft (48 Nm).

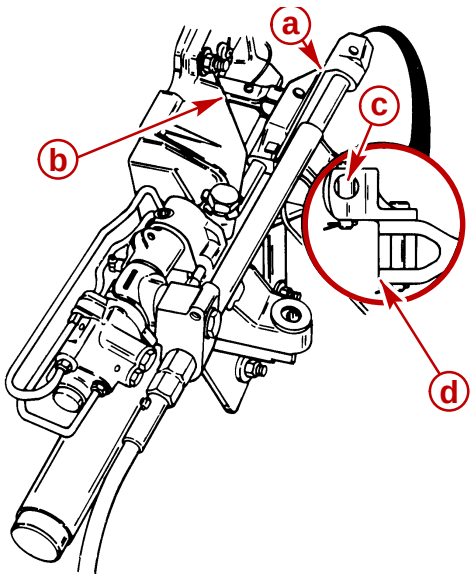
10. Install and tighten locking plate on coupler nut. Secure with self-locking bolt and washer (if required).



50927

a - Clevis Pin
b - Cotter Pin
c - Self-Locking Coupler Nut
d - Steering Cable

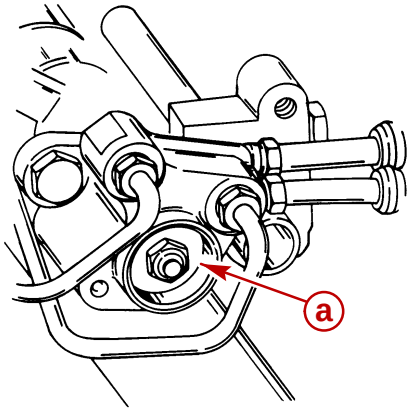
11. Reconnect power steering control valve piston rod end clevis to drive unit steering lever.



50927

a - Clevis
b - Steering Lever
c - Pin
d - Cotter Pin

12. Place 2-4-C Marine Lubricant with Teflon in adjustment nut cavity and reinstall dust cover.



22023

a - Adjustment Nut Cavity

13. Restart engine and observe drive unit. If drive unit still creeps in one direction or the other, an external tension may exist on steering cable. Ensure that nothing is attached to steering cable (pushing or pulling).

Steering Cable Selection, Removal and Installation

Selection

Steering system has the steering cable guide tube set for cables with end dimensions which comply with the BIA Certification Handbook. Refer to “Steering Cable Specifications” listed previously in this section.

⚠ CAUTION

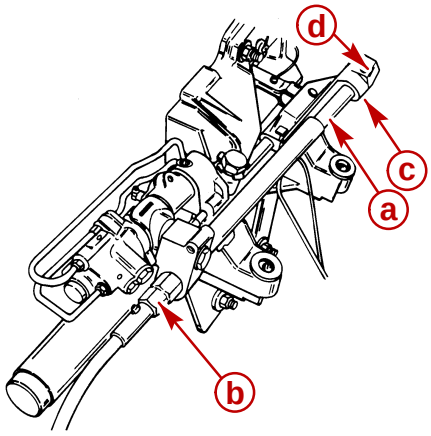
If cables with improper dimensions are installed, severe damage to transom assembly and/or steering system may result.

⚠ CAUTION

Steering cables MUST BE THE CORRECT LENGTH, particularly when installed in large boats. Sharp bends or too-short cables result in kinks; too-long cables require unnecessary bends and/or loops. Both place an extra stress on the cable. The proper cable is as short as possible, with the fewest bends and with radii as large as possible.

Removal

1. Remove steering cable.



50912

a - Steering Cable
b - Self-Locking Cable Coupler Nut
c - Cotter Pin
d - Clevis Pin

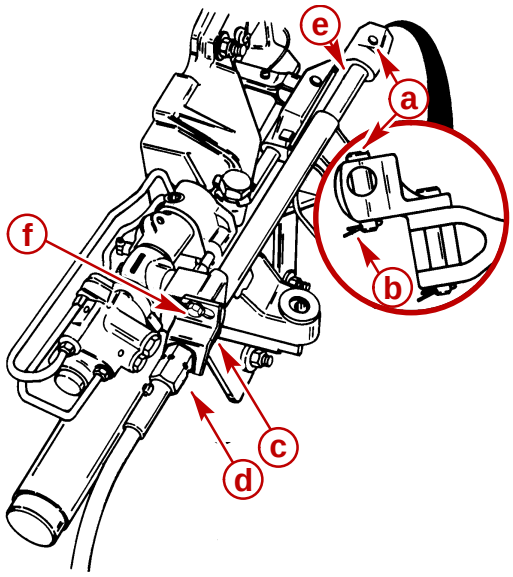
Installation

⚠ WARNING

Steering cable outer casing MUST BE free to move back-and-forth for steering to function properly. DO NOT fasten any wires, cables or other items to steering cable, as this may prevent it from moving.

1. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
2. **Later model control valve:** Using a suitable wrench, hold the flat surfaces on the cable guide tube in the vertical position.
3. **Both models:** Torque coupler nut to 35 lb-ft (48 Nm).
4. **Earlier model control valve:** Install and tighten locking plate on coupler nut. Secure with self locking bolt and washer.

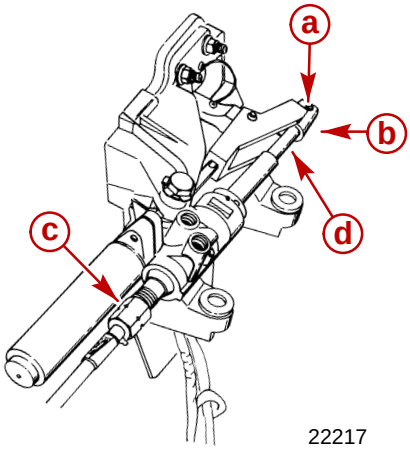
NOTE: *Later model control valves do not have a locking plate on the coupler nut*



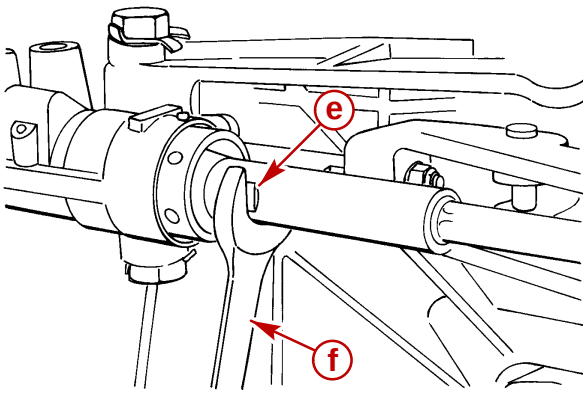
50352

Earlier Model Control Valve

a - Clevis Pin
b - Cotter Pin
c - Locking Plate (If No Self Locking Coupler Nut)
d - Coupler Nut
e - Steering Cable
f - Bolt and Washer



22217



73901

Later Model Control Valve

a - Clevis Pin
b - Cotter Pin
c - Coupler Nut
d - Steering Cable
e - Flat (Hold Vertical)
f - Suitable Wrench

Installation

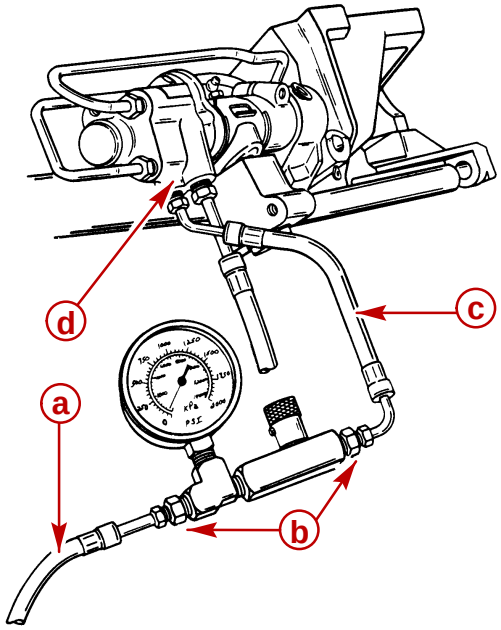
⚠ WARNING

Steering cable outer casing MUST BE free to move back-and-forth for steering to function properly. DO NOT fasten any wires, cables or other items to steering cable, as this may prevent it from moving.

1. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
2. **Later model control valve:** Using a suitable wrench, hold the flat surfaces on the cable guide tube in the vertical position.
3. **Both models:** Torque coupler nut to 35 lb-ft (48 Nm).
4. **Earlier model control valve:** Install and tighten locking plate on coupler nut. Secure with self locking bolt and washer.

NOTE: *Later model control valves do not have a locking plate on the coupler nut.*

5. Install test gauge assembly between control valve and pump pressure hose. Tighten all fittings securely, but DO NOT OVERTIGHTEN.



22146

a - Pump Pressure Hose
b - Gauge Fitting
c - Gauge Valve Hose
d - Control Valve

Power Steering Pump Lugging Test

⚠ CAUTION

DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing, or over-heating damage to engine may result.

⚠ WARNING

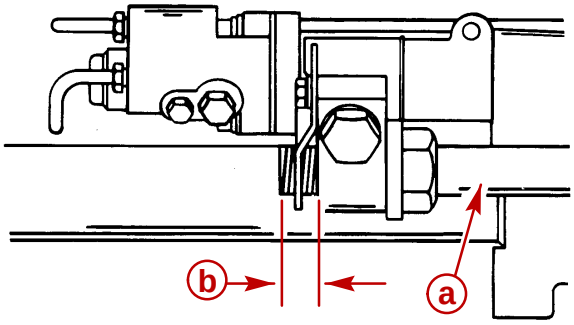
Steering cable outer casing MUST BE free to move back-and-forth for Power Steering to function properly. Make sure that no wires, cables, or other items are fastened to steering cable, as this may prevent it from moving.

⚠ CAUTION

If Power Steering pump lugs when steering wheel is turned to end of travel in either direction (left or right), damage to steering system and/or sterndrive may result.

IMPORTANT: Make sure that Power Steering pump is filled to proper level before proceeding.

1. Completely open test gauge.
2. Start engine and run at idle speed.
3. Turn steering wheel to **hard left** and observe reading on gauge. If pressure reading is higher than 300 psi (2069 kPa), stop engine and check the following:
   a. Check for an obstruction between gimbal ring and gimbal housing and all moving steering system components.
   b. Check that steering lever is not contacting cutout in transom. If contact is being made, modify cutout.
   c. Check steering cable guide tube dimensions and adjust as necessary.



22137

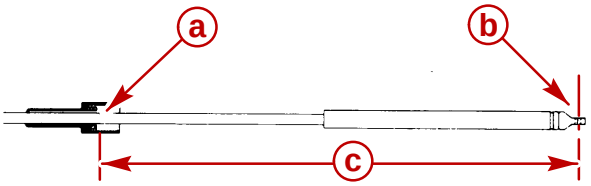
a - Steering Cable Guide Tube
b - 5/8-7/8 in. (16-22 mm) [Ideal 3/4 in. (19 mm)]

4. With engine running, turn steering wheel to **hard right** and observe reading on gauge. If reading is higher than 300 psi (2069 kPa), stop engine and check the following.

   a. Check for an obstruction between gimbal ring, and gimbal housing and all moving steering system components.

   b. Check that steering lever is not contacting cutout in transom. If contact is being made, modify cutout.

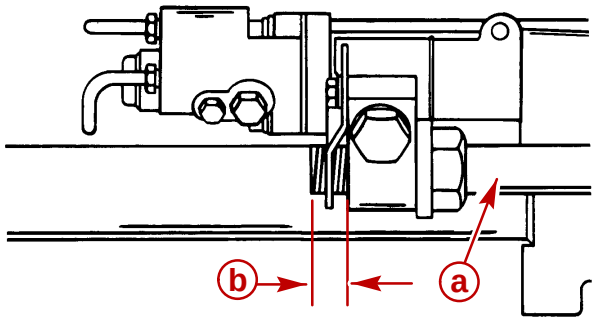
   c. Check steering cable end dimensions with cable fully extended. If excessive, replace cable and/or steering head as required.



22469

a - Steering Cable Mounting Flange
b - Center of Hole in Steering Cable End
c - 21-3/8 in. (543 mm)

   d. Check steering cable guide tube dimension and adjust as necessary.



22137

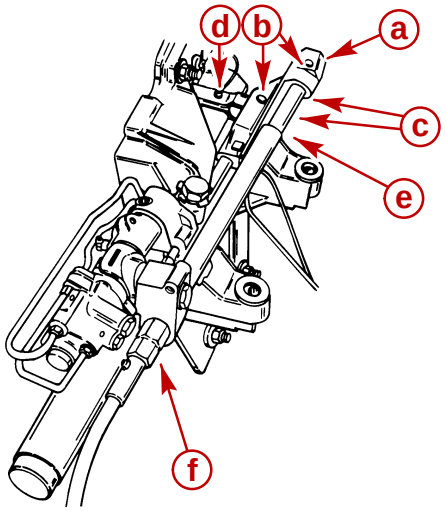
a - Steering Cable Guide Tube
b - 5/8-7/8 in. (16-22 mm) [Ideal 3/4 in. (19 mm)]

Power Steering System Pressure Test

IMPORTANT INFORMATION

The following instructions are arranged so that a defective part can be detected by the process of elimination. It is suggested that the order of the instructions be followed so that the Power Steering System can be tested effectively.

1. Remove steering cable from Power Steering unit and disconnect Power Steering unit from steering lever.

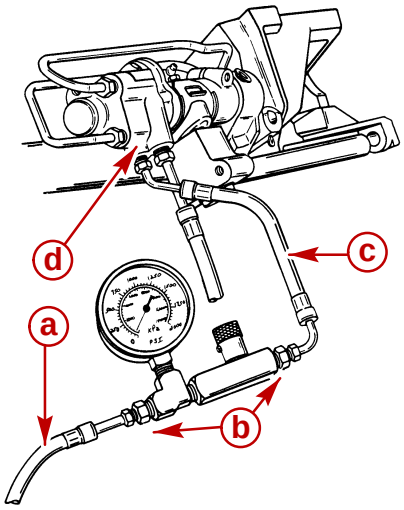


50912

a - Clevis
b - Pins (2)
c - Cotter Pins (2) - Hidden
d - Steering Lever
e - Steering Cable
f - Self-Locking Coupler Nut

2. Assemble and install test gauge.

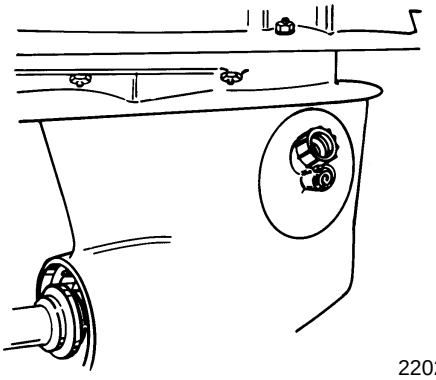
3. Open valve on gauge completely.



22146

a - Pump Pressure Hose
b - Gauge Fitting
c - Gauge Valve Hose
d - Control Valve

4. Connect a flush test device to drive unit. Partially open water tap (approximately 1/2 max.) and allow cooling system to fill completely. Cooling system is full when water is discharged through the propeller. DO NOT use full water tap pressure.



22029

5. Start engine and run at 1000-1500 rpm until engine reaches normal operating temperature.
6. With engine at idle speed, test gauge reading should be between 70 and 125 psi (483 and 862 kPa). If not, proceed as follows:

If lower than 70 psi (483 kPa), proceed to “Pump Pressure Test,” see “Index.”

If higher than 125 psi (862 kPa), check for hose restrictions in the system.

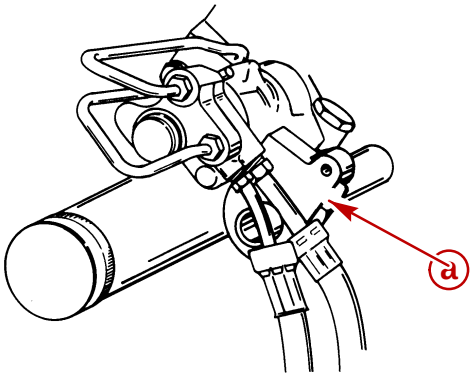
⚠ CAUTION

DO NOT lug pump at maximum pressure for more than 5 seconds, in next step, or damage to Power Steering pump may occur.

7. Push control valve adaptor block **momentarily** to the **left** and then to the **right**. Gauge reading should show an instant increase in pressure when block is pushed in both directions.

8. Push control valve adaptor block to the **right**, until booster cylinder piston rod is fully retracted. With piston rod in this position, **momentarily** push adaptor block to the **right** until maximum pressure reading is obtained.

- **If pressure is above 1000 psi (6897 kPa),** system pressure is good.
- **If pressure is below 1000 psi (6897 kPa),** conduct “Pump Pressure Test,” see “Index.”



22023

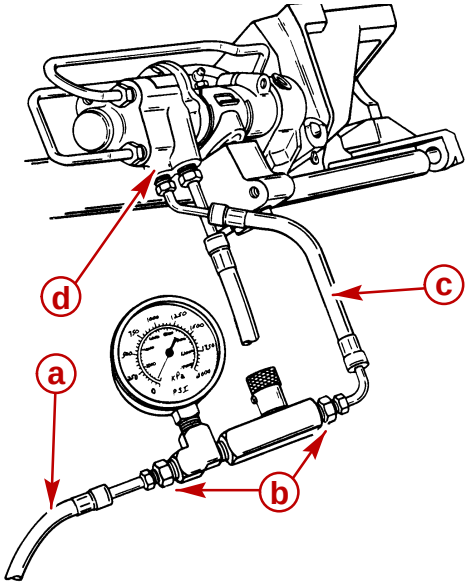
a - Control Valve Adaptor Block

Pump Pressure Test

⚠ CAUTION

In performing the following test, DO NOT lug pump at maximum pressure for more than 5 seconds or damage to Power Steering pump may occur.

1. Install test gauge.

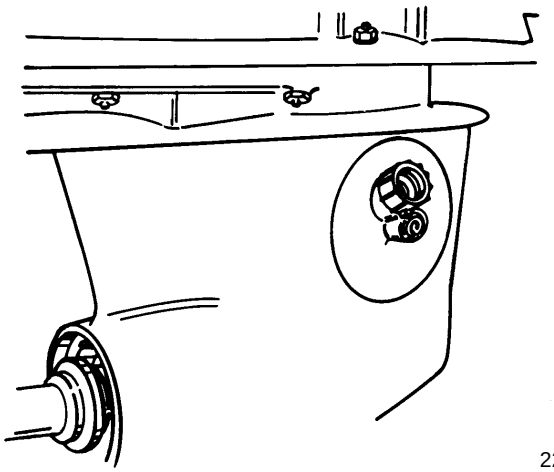


22146

a - Pump Pressure Hose
b - Gauge Fitting
c - Gauge Valve Hose
d - Control Valve

DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing, or overheating damage to engine may result.

2. Connect a flush test device to drive unit. Partially open water tap (approximately 1/2 max.) and allow water to enter cooling system. DO NOT use full water tap pressure.



22029

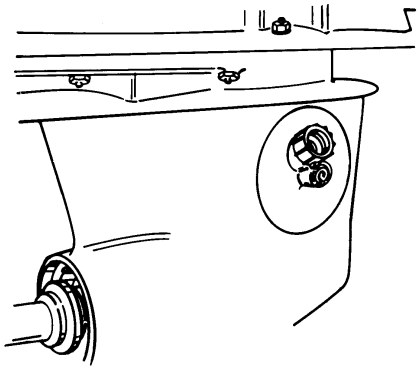
3. Start engine and run at 1000-1500 rpm until engine reaches normal operating temperature.
4. Close test gauge valve just long enough to obtain maximum pressure reading.
5. Close and open valve 3 times. Record highest pressure reading attained each time.
   a. **If pressure readings are between 1150 and 1250 psi (7932-8621 kPa) and are within a range of 50 psi (345 kPa),** the pump is within specifications. If the **pump** tests OK, but system pressure was low (as tested under “Power Steering System Pressure Test,” see “Index”), proceed to “Booster Cylinder Test,” see “Index.”
   b. **If pressure readings are between 1150-1250 psi (7932-8621 kPa), but are not within a 50 psi (345 kPa) range,** the Power Steering pump flow control valve is sticking or pump hydraulic system is dirty.
   c. **If pressure readings are constant, but below 1000 psi (6897 kPa),** replace Power Steering pump.

Booster Cylinder Test

⚠ CAUTION

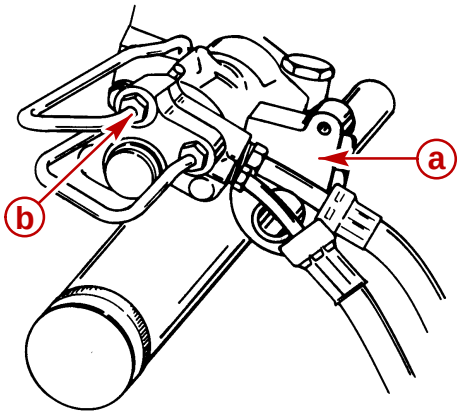
DO NOT operate engine without cooling water being supplied to water pickup holes in gear housing, or over-heating damage to engine may result.

1. Connect a flush test device to drive unit. Partially open water tap (approximately 1/2 max.) and allow water to enter cooling system. DO NOT use full water tap pressure.



22029

2. Start engine.
3. Push control valve adaptor block to the right until booster cylinder rod is fully retracted.
4. Stop engine.
5. Remove top metal hydraulic line from control valve.
6. Plug port in control valve and cap end of metal line with cap and plug supplied in test gauge kit.



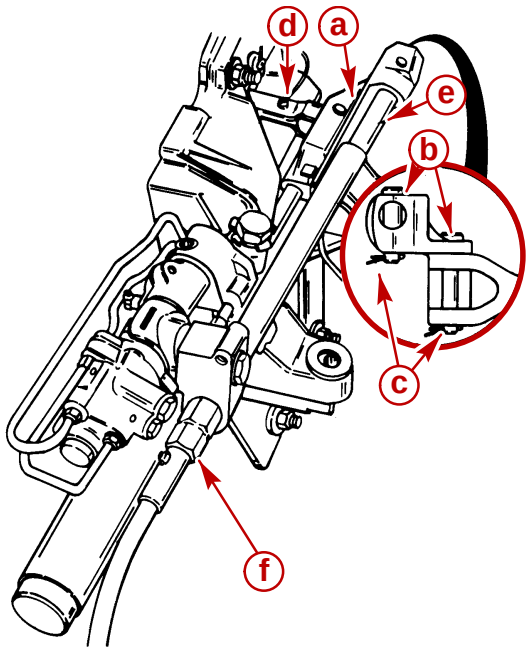
22023

a - Adaptor Block - Push To Right
b - Top Metal Line

⚠ CAUTION

DO NOT lug pump at maximum pressure for more than 5 seconds, in next step, or damage to Power Steering pump may occur.

7. Start engine.
8. Push control valve adaptor block **momentarily** to the right and observe for conditions “a” or “b,” following:
   a. **If piston rod extends,** booster cylinder is leaking and must be replaced. After replacement, repeat “Power Steering System Pressure Test.” If pressure is still low, replace control valve.
   b. **If piston rod does not extend, but pressure was low when performing “Power Steering System Pressure Test,”** replace control valve.
9. Stop engine.
10. Connect power steering piston rod clevis to drive unit steering lever. Secure with pin and cotter pin.
11. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
12. Torque self-locking coupler nut to 35 lb-ft (48 Nm).

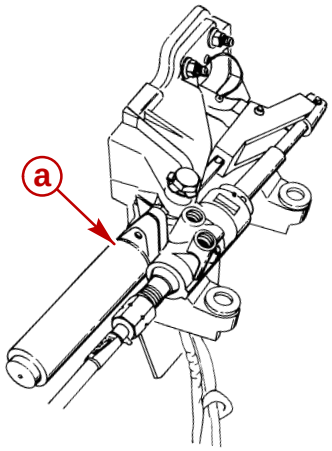


50927

a - Clevis
b - Pins (2)
c - Cotter Pins (2)
d - Steering Lever
e - Steering Cable
f - Self-Locking Coupler Nut

Power Steering Component Repair

NOTE: *DO NOT attempt to repair or adjust the later model control valve.*



22217

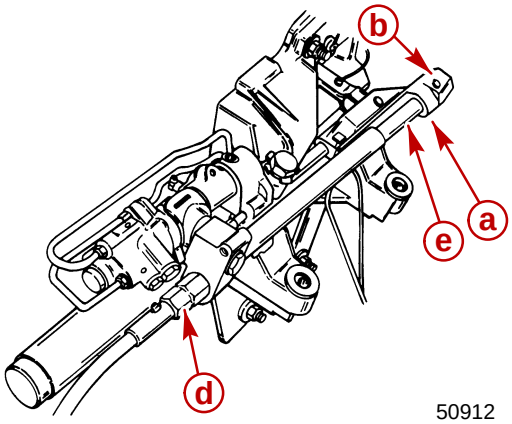
Later Model Control Valve

a - Later Model Control Valve (Do Not Repair or Adjust)

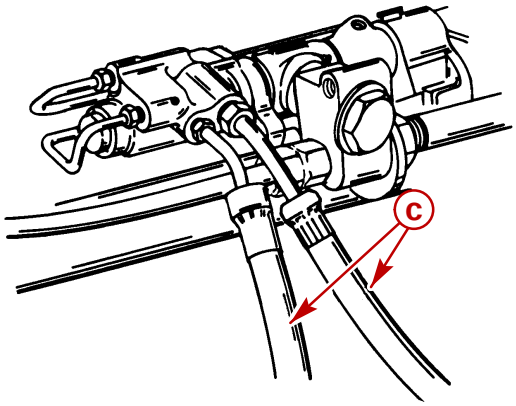
Power Steering Unit

REMOVAL

1. Remove steering cable and Power Steering pump fluid hoses.



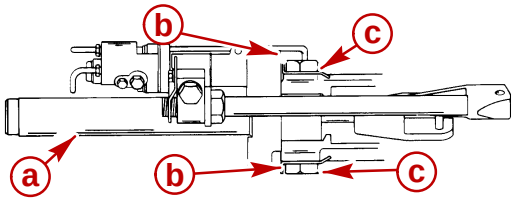
50912



50912

a - Cotter Pin (Hidden)
b - Clevis Pin
c - Power Steering Pump Fluid Hoses - Remove and Plug
d - Self-Locking Cable Coupler Nut
e - Steering Cable

2. Remove Power Steering unit.

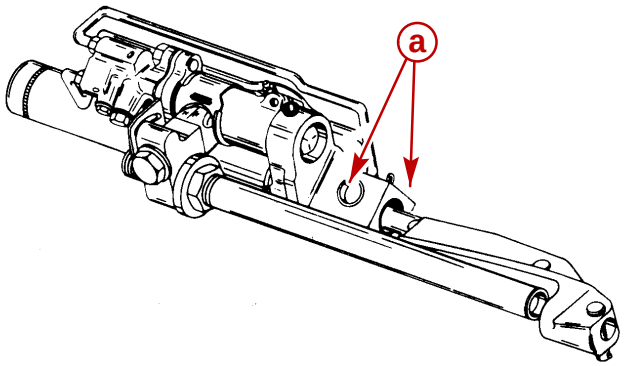


22137

a - Power Steering Unit
b - Tab Washer - Bend Tab Away from Pivot Bolt
c - Pivot Bolt

INSTALLATION

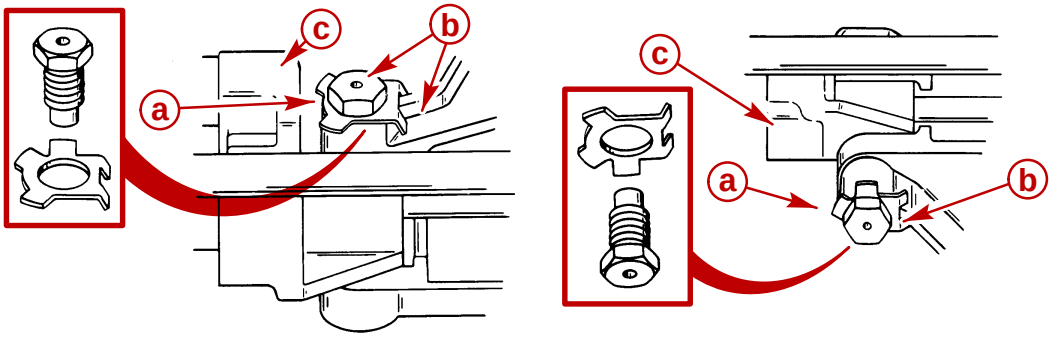
1. Lubricate power steering unit bushings with Special Lubricant 101..



22167

a - Bushings

2. Lubricate pivot bolts with Special Lubricant 101.
3. HAND THREAD pivot bolts all-the-way into inner transom plate and swivel ring. DO NOT use a wrench.
4. Straddle tab washer tangs on inner transom plate ridge.

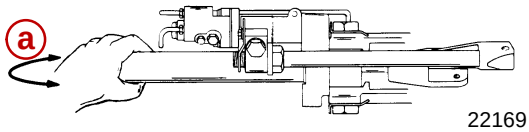


22168

a - Pivot Bolts - HAND THREAD into Transom Plate and Power Steering Unit
b - Tab Washer - Straddle Inner Transom Plate Ridge
c - Swivel Ring

5. Torque pivot bolts to 25 lb-ft (35 Nm). Bend washer tabs against corresponding flats on bolt tabs.

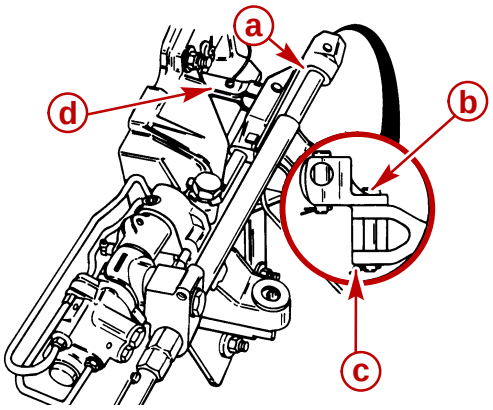
6. Move power steering unit back-and-forth to ensure that it pivots freely.



22169

a - Move Power Steering Unit Back-and-Forth

7. Connect power steering piston rod clevis to drive unit steering lever. Secure with pin and cotter pin.

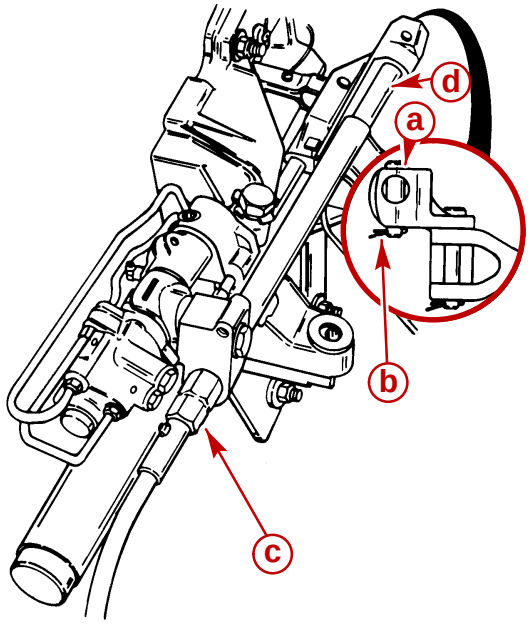


50927

a - Clevis
b - Pin
c - Cotter Pin
d - Steering Lever

8. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.

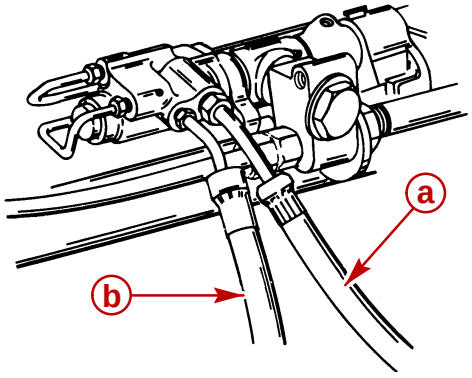
9. Torque self-locking coupler nut to 35 lb-ft (48 Nm).



50927

a - Clevis Pin
b - Cotter Pin
c - Self-Locking Coupler Nut
d - Steering Cable

10. Connect power steering pump hoses to their respective fittings on control valve. Torque large hose fitting to 20-25 lb-ft (27-34 Nm). Torque the small hose fitting to 96-108 lb-in. (11-12 Nm).



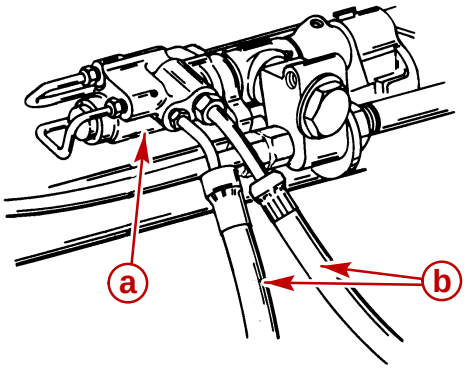
50912

a - Hose (Large Fitting)
b - Hose (Small Fitting)

Cable Guide Tube (Early Style Only)

REMOVAL

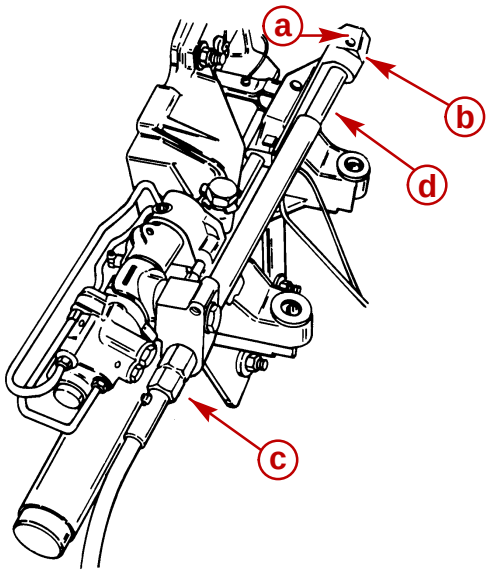
1. Remove power steering pump hoses from control valve. Cap hoses and plug holes in control valve.



50912

a - Control Valve
b - Pump Hoses

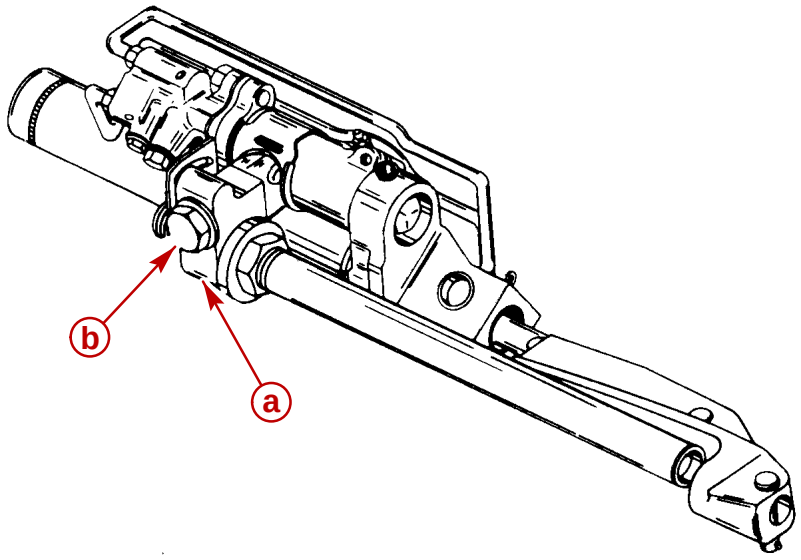
2. Remove steering cable from power steering control valve.



50912

a - Clevis Pin
b - Cotter Pin (Hidden)
c - Self-Locking Coupler Nut
d - Steering Cable

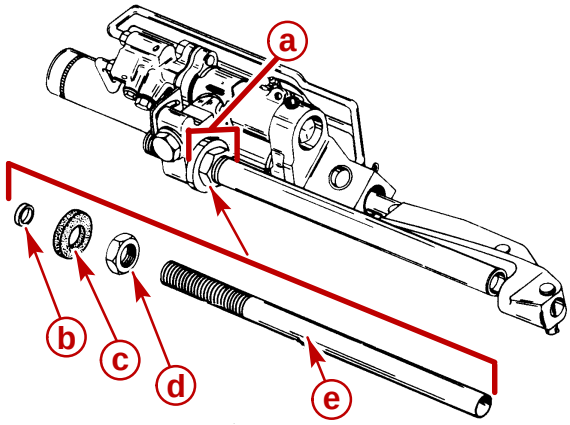
3. Remove adaptor block as follows:
   a. Loosen adaptor block nut.
   b. Tap adaptor nut with hammer to loosen block.
   c. Remove nut; then remove block.



22137

a - Adaptor Block
b - Nut

4. Heat area shown (to break down Loctite), and remove steering tube bushing, guide, and nut. Remove cable guide tube.



22137

a - Heat in This Area
b - Steering Tube Bushing
c - Steering Tube Guide
d - Steering Tube Nut
e - Cable Guide Tube

INSTALLATION

⚠ WARNING

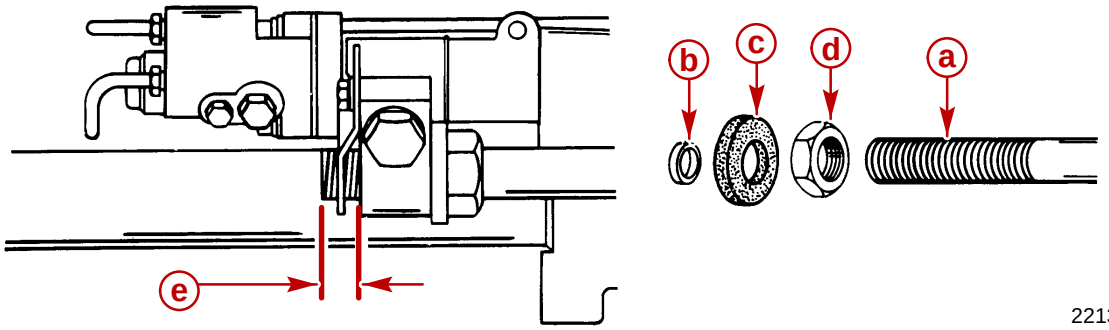
Loctite MUST BE applied to cable guide tube threads to prevent tube from loosening during operation.

1. Clean guide tube threads with a wire brush to remove old Loctite. Apply Quicksilver Loctite 8831 or 271 to guide tube threads in the area where adaptor block and locknut will be installed.

22137

a - Loctite 8831 or 271 to Threads of Cable Guide Tube

2. Reinstall steering tube and related hardware and position so that threaded end of tube protrudes exactly 3/4 in. (19 mm) through adaptor block. Torque steering tube nut to 40 lb-ft (54 Nm).

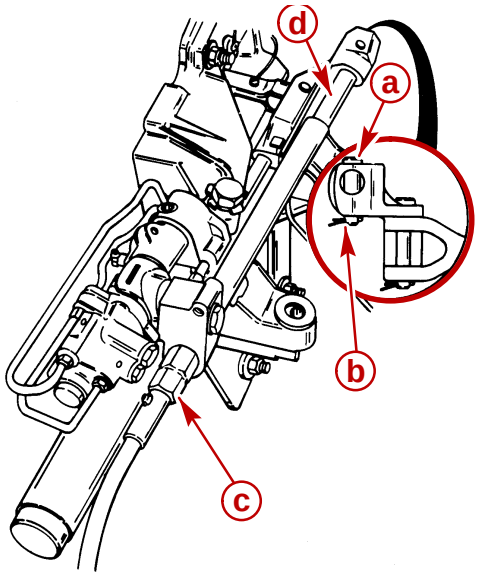


22137

a - Steering Guide Tube
b - Steering Tube Bushing
c - Steering Tube Guide
d - Steering Tube Nut
e - 3/4 in. (19 mm)

3. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.

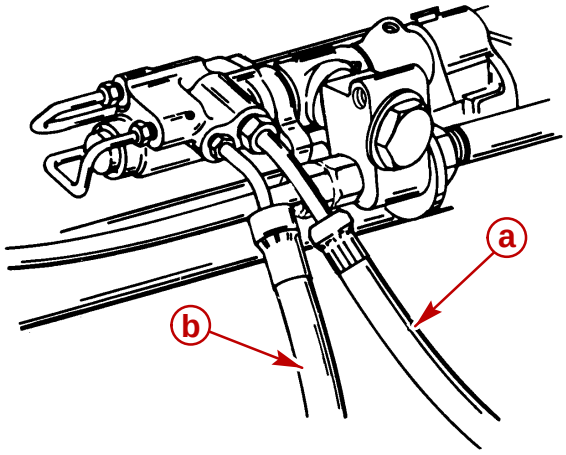
4. Torque self-locking coupler nut to 35 lb-ft (48 Nm).



50927

a - Clevis Pin
b - Cotter Pin
c - Self-Locking Coupler Nut
d - Steering Cable

5. Connect power steering pump hoses to their respective fittings on control valve.



50912

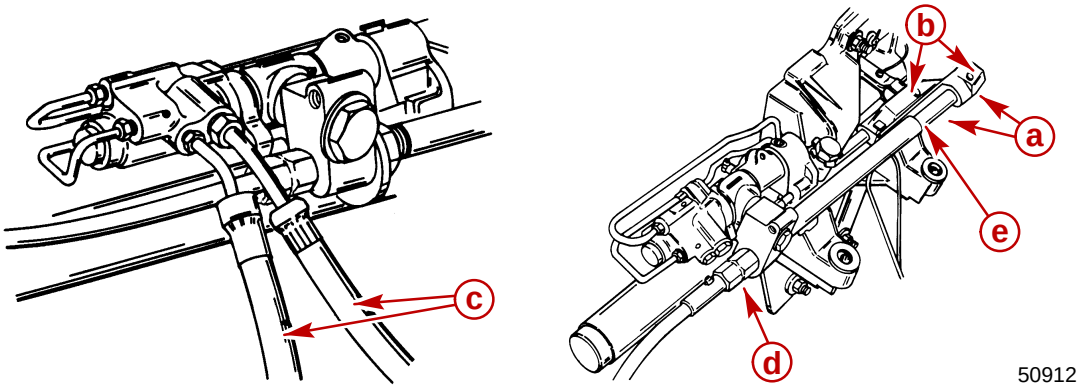
a - Hose (Large Fitting) - Torque to 20-25 lb-ft (27-34 Nm)
b - Hose (Small Fitting) - Torque to 96-108 lb-in. (11-12 Nm)

Control Valve (Early Style Only)

NOTE: *If accessibility to control valve area is limited, remove Power Steering unit from transom assembly, to gain easier access to control valve.*

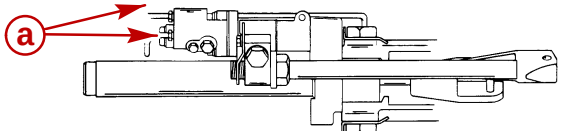
REMOVAL

1. Remove steering cable and Power Steering pump fluid hoses.



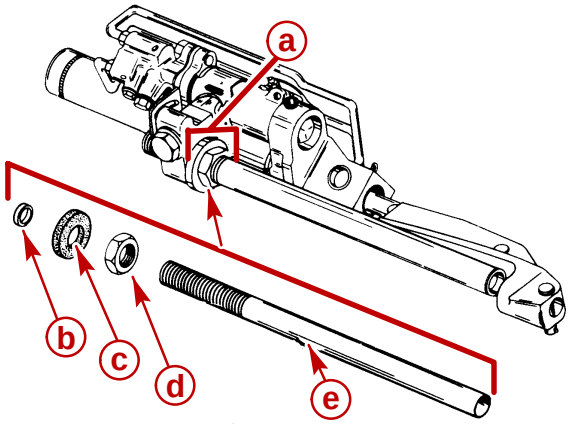
a - Cotter Pins (Hidden)
b - Clevis Pins
c - Power Steering Pump Fluid Hoses - Remove and Plug
d - Cable Self-Locking Coupler Nut
e - Steering Cable

2. Remove tubes from control valve.



a - Metal Tubes

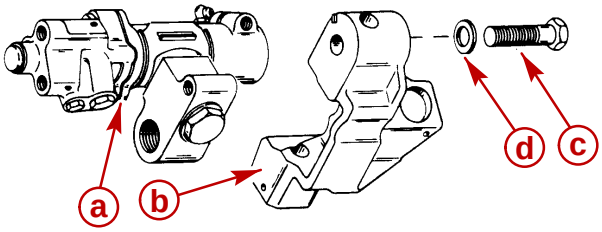
3. Heat area shown (to breakdown Loctite), and remove steering tube bushing, guide and nut.



22137

a - Heat this Area
b - Steering Tube Bushing
c - Steering Tube Guide
d - Steering Tube Nut
e - Cable Guide Tube

4. Remove control valve from adaptor block assembly.

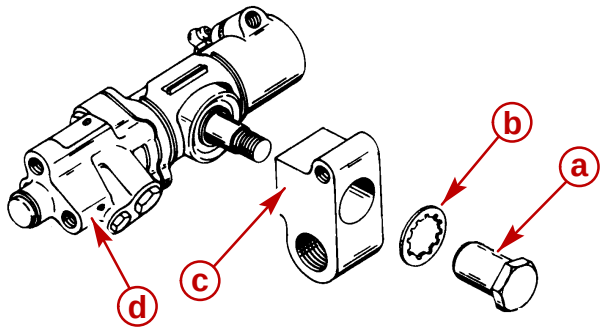


22143

a - Control Valve
b - Adaptor Block Assembly
c - Screw
d - Washer

DISASSEMBLY

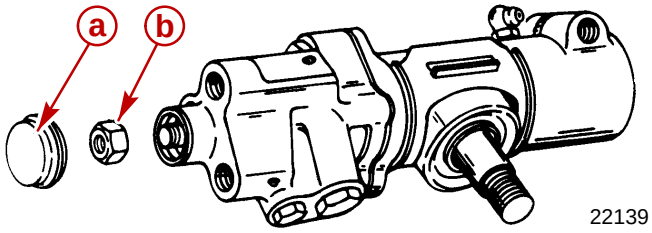
1. Remove adaptor block as follows:
   Loosen adaptor block nut. Tap adaptor nut with hammer to loosen block. Remove nut, washer and adaptor block.



22143

a - Adaptor Block Nut
b - Washer
c - Adaptor Block
d - Control Valve

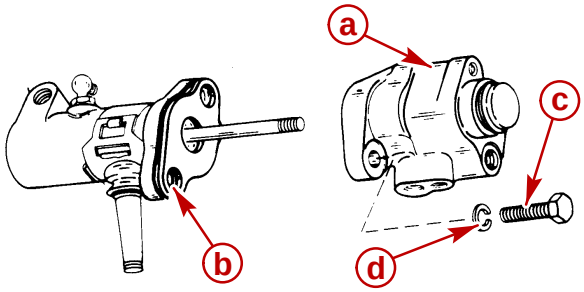
2. Remove dust cover and adjusting nut.



22139

a - Dust Cover
b - Adjusting Nut

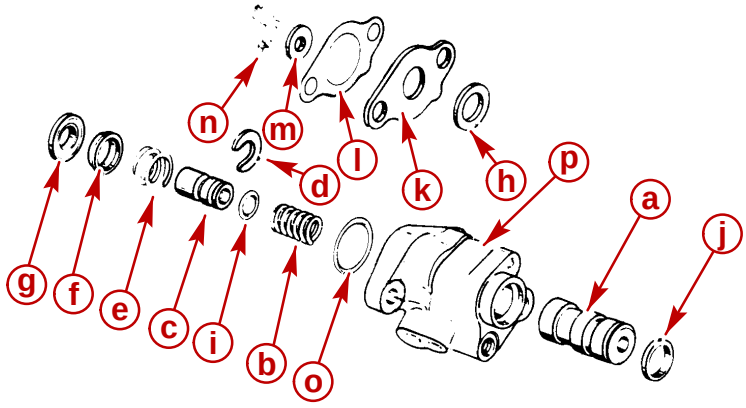
3. Separate valve housing from adaptor.



22145

a - Valve Housing
b - Adaptor
c - Screws (2)
d - Lockwashers (2)

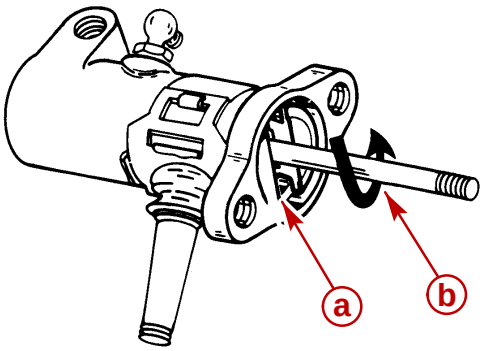
4. Remove components shown.



22138

a - Valve Spool
b - Valve Adjustment Spring
c - Reaction Spool
d - Spring Thrust Washer
e - Valve Spring
f - Spring Retainer
g - Annulus Seal
h - Large ID Washer
i - Reaction Spool O-ring
j - Valve Spool “V” Block Seal
k - Annulus Spacer
l - Gasket
m - Small Washer
n - Plug to Sleeve Key
o - O-ring
p - Valve Housing

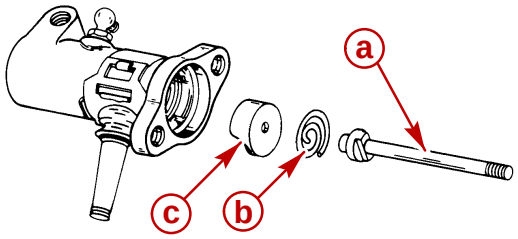
5. Carefully (so as not to nick the top surface) turn adjuster plug out of sleeve.



22139

a - Adjuster Plug
b - Turn Counterclockwise

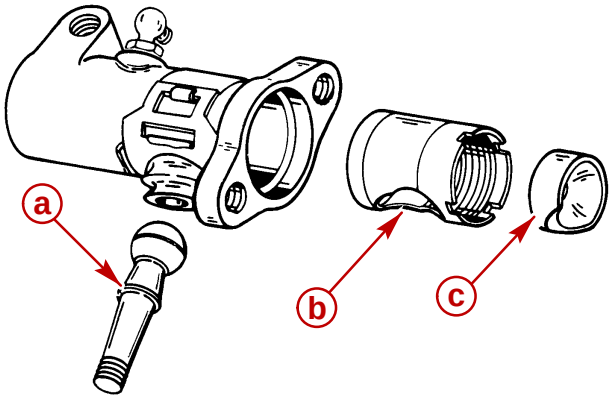
6. Remove components shown.



22139

a - Valve Shaft
b - Ball Seal Spring
c - Upper Ball Seat

7. Remove sleeve bearing and lower ball seat.



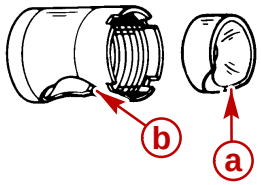
22140

a - Ball Stud - Pull Up into Rubber Boot
b - Sleeve Bearing
c - Lower Ball Seat

8. Clean and inspect metal parts. If any metal part shows signs of wear, replace control valve assembly.

REASSEMBLY

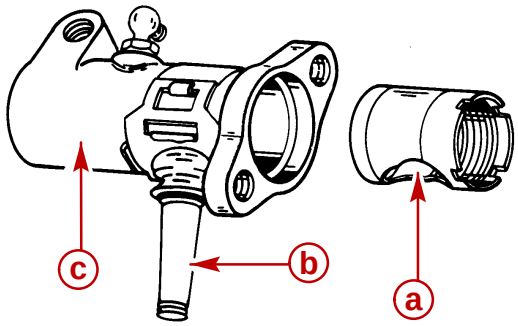
1. Install lower ball seat into sleeve bearing.



22140

a - Lower Ball Seat
b - Sleeve Bearing

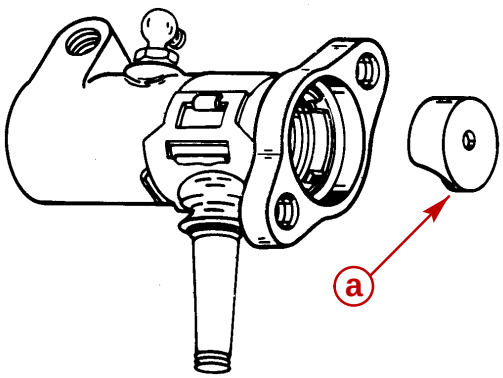
2. Install sleeve bearing.



22140

a - Sleeve Bearing
b - Ball Stud - Pull Up into Rubber Boot
c - Adaptor Housing

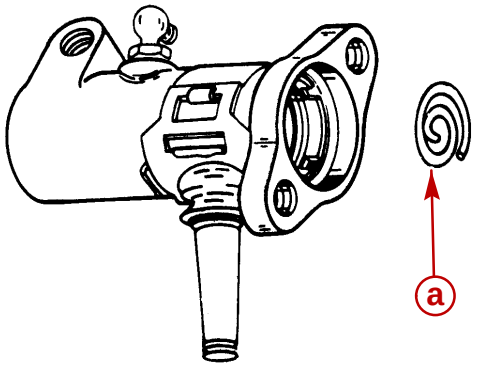
3. Position ball stud in sleeve bearing.
4. Install upper ball seat.



22141

a - Upper Ball Seat

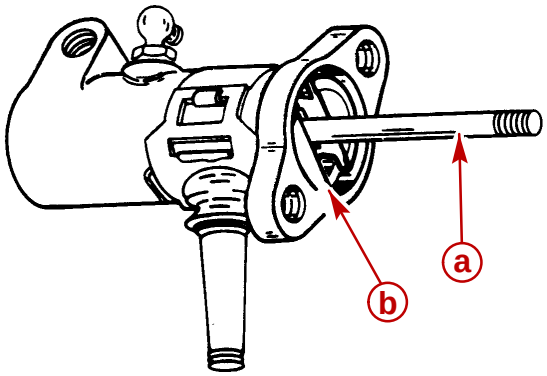
5. Install ball seat spring.



22141

a - Ball Seat Spring - Small Coil Down

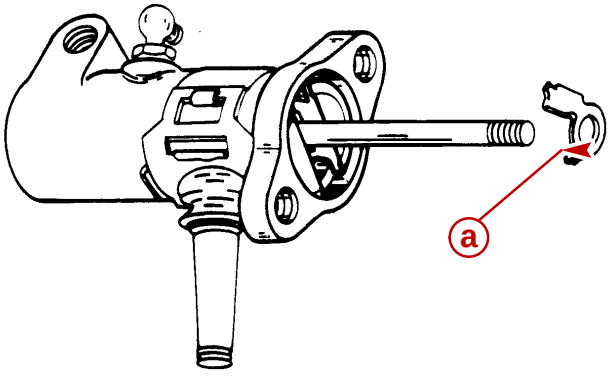
6. Insert valve shaft into adjuster plug. Screw adjuster plug into sleeve until tight; then back-off plug until slot lines up with notches in sleeve.



22139

a - Valve Shaft
b - Adjuster Plug

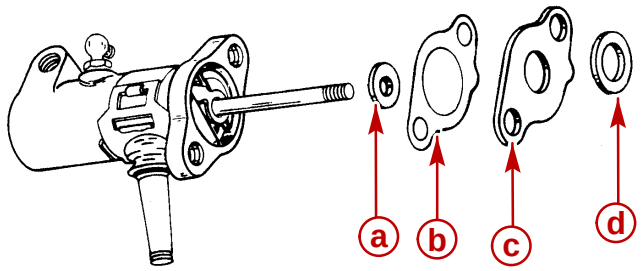
7. Install key.



22141

a - Key - Tangs on Key to Fit into Notches in Sleeve

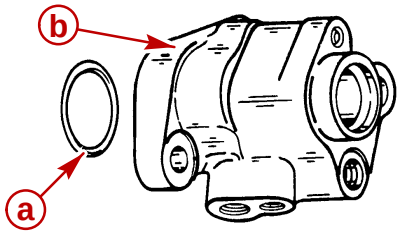
8. Install components shown.



22141

a - Valve Shaft Washer
b - Gasket
c - Annulus Spacer
d - Large ID Washer

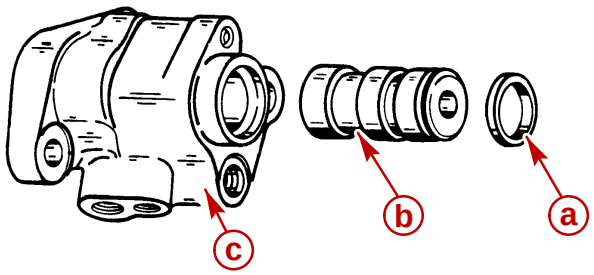
9. Install O-ring in control valve housing.



22142

a - O-ring
b - Control Valve Housing

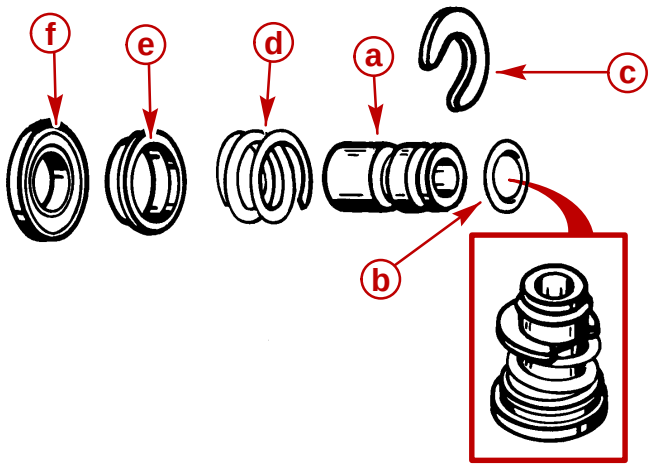
10. Install “V” block seal. Insert valve spool into adjusting nut end of control valve.



22142

a - “V” Block Seal - Lip of Seal Facing Lands on Spool
b - Spool
c - Control Valve

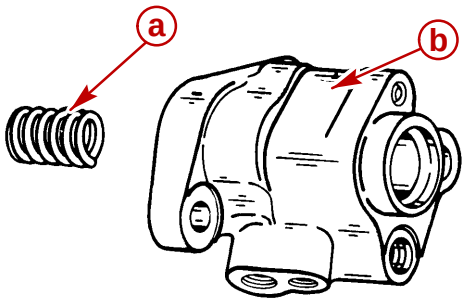
11. Assemble reaction spool.



22142

a - Reaction Spool
b - O-ring
c - Thrust Washer
d - Valve Spring
e - Spring Retainer
f - Annulus Seal - Lip Facing O-ring End of Spool

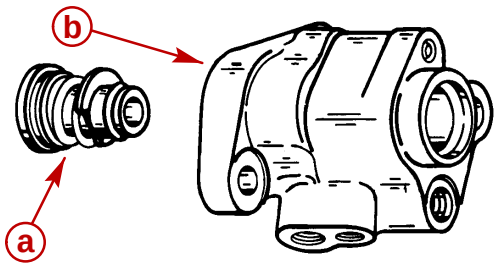
12. Install valve adjustment spring.



22142

a - Valve Adjustment Spring
b - Control Valve

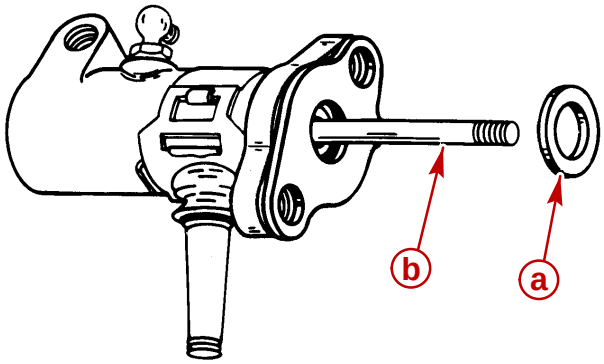
13. Install reaction spool assembly into larger control valve cavity.



22142

a - Reaction Spool Assembly
b - Control Valve - Large Cavity

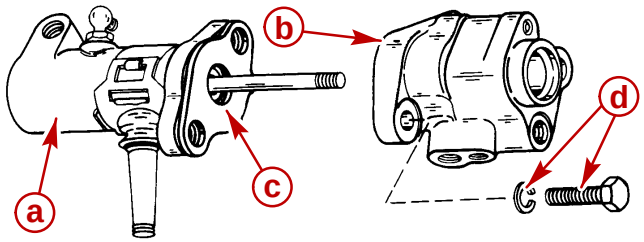
14. Install large ID washer.



22144

a - Large ID Washer
b - Valve Shaft

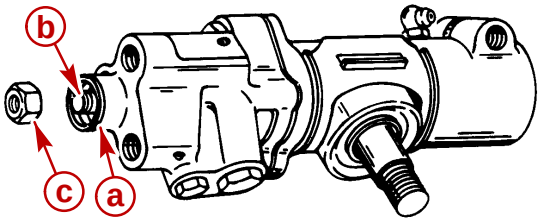
15. Match annulus spacer to control valve housing. Secure adaptor housing to control valve housing.



22144

a - Annulus Spacer
b - Control Valve Housing
c - Adaptor Housing
d - Screws and Washers (2 Each) - Torque Screws to 20-30 lb-ft (27-41 Nm)

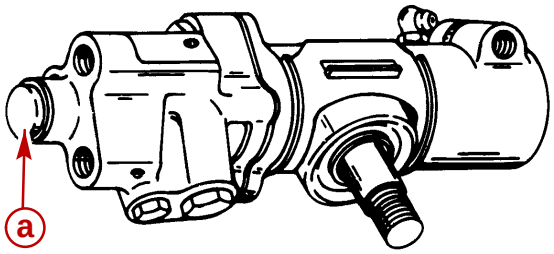
16. Depress valve spool. Install locknut-thread about 4 turns.



22139

a - Valve Spool
b - Valve Shaft
c - Locknut

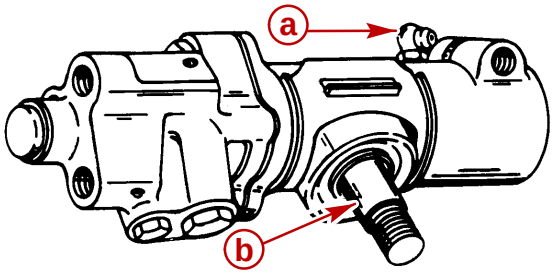
17. Install dust cover.



22143

a - Dust Cover

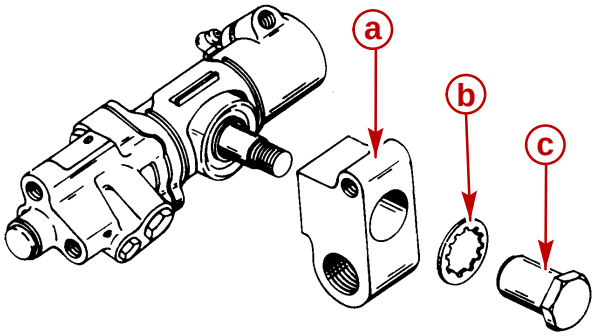
18. Lubricate control valve with Quicksilver 2-4-C Marine Lubricant with Teflon until lubricant appears around rubber boot.



22143

a - Grease Fitting
b - Rubber Boot

19. Install adaptor block.

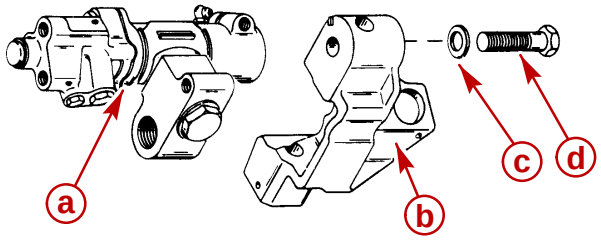


22143

a - Adaptor Block
b - Internal Lockwasher
c - Nut - Torque to 30-40 lb-ft (41-54 Nm)

INSTALLATION

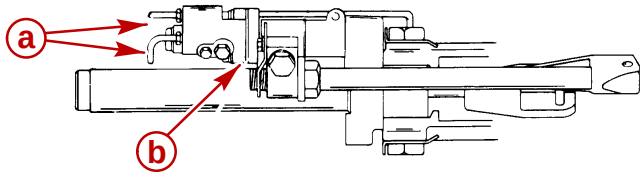
1. Secure control valve to adaptor block assembly. Torque to 25-35 lb-ft (34-47 Nm).



22143

a - Control Valve
b - Adaptor Block Assembly
c - Washer
d - Screw-

2. Install metal tubes onto control valve.



22137

a - Metal Tubes
b - Control Valve

⚠ WARNING

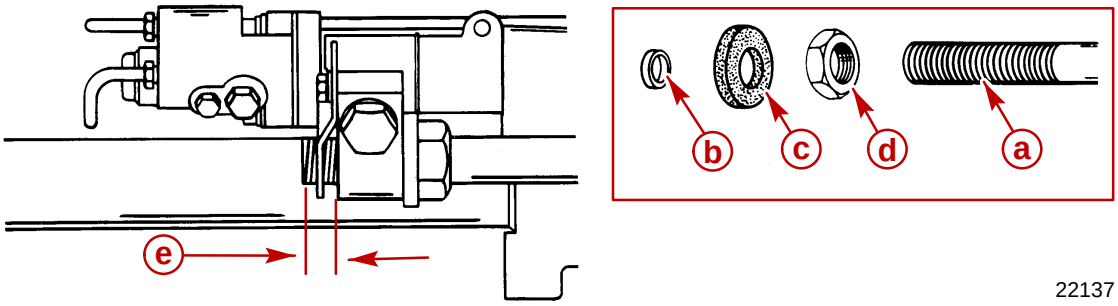
Loctite MUST BE applied to cable guide tube threads to prevent tube from loosening during operation.

3. Clean guide tube threads with a wire brush to remove old Loctite. Apply a liberal amount of Loctite 8831 or 271 to guide tube threads in the area where adaptor block and locknut will be installed.

22137

a - Loctite 8831 or 271 to Threads of Cable Guide Tube

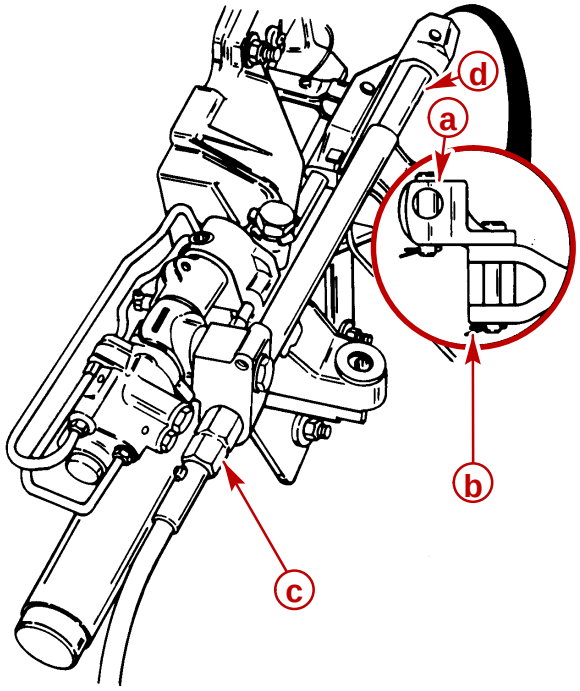
4. Reinstall steering tube and related hardware and position so that threaded end of tube protrudes exactly 3/4 in. (19 mm) through adaptor block. Torque steering tube nut to 40 lb-ft (54 Nm).



22137

a - Steering Guide Tube
b - Steering Tube Bushing
c - Steering Tube Guide
d - Steering Tube Nut
e - 3/4 in. (19 mm)

5. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
6. Torque self-locking coupler nut to 35 lb-ft (48 Nm).

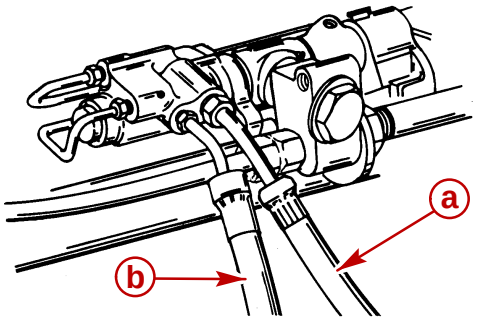


50927

a - Clevis Pin
b - Cotter Pin
c - Self-Locking Coupler Nut
d - Steering Cable

7. Connect power steering pump hoses to the respective fittings on control valve.
8. Torque large hose fitting to 23 lb-ft (30.5 Nm).

9. Torque the small hose fitting to 102 lb-in. (11.5 Nm).



50912

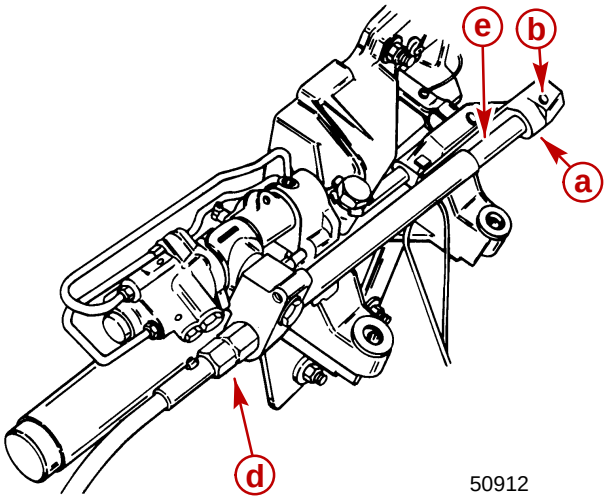
a - Hose (Large Fitting)
b - Hose (Small Fitting)

Booster Cylinder (Early Style Only)

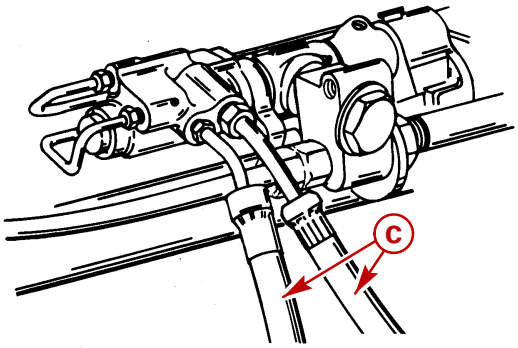
REMOVAL

NOTE: *If accessibility to booster cylinder area is limited, remove Power Steering unit from transom assembly to gain easier access to booster cylinder.*

1. Remove steering cable and Power Steering pump fluid hoses.



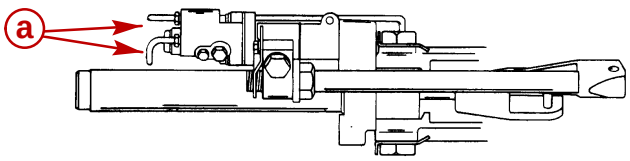
50912



50912

a - Cotter Pin (Hidden)
b - Clevis Pin
c - Power Steering Pump Fluid Hoses - Remove and Plug
d - Self-Locking Cable Coupler Nut
e - Steering Cable

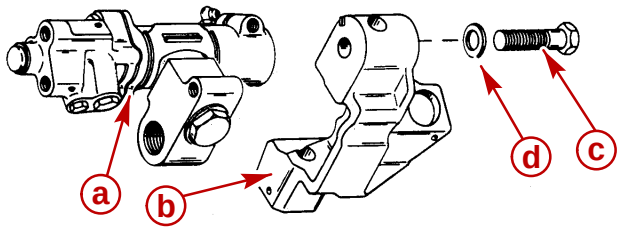
2. Remove metal lines from control valve.



22137

a - Metal Lines

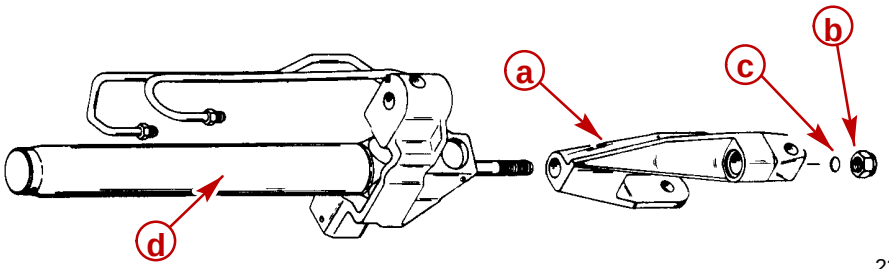
3. Remove control valve from adaptor block assembly.



22143

a - Control Valve
b - Adaptor Block Assembly
c - Screw
d - Washer

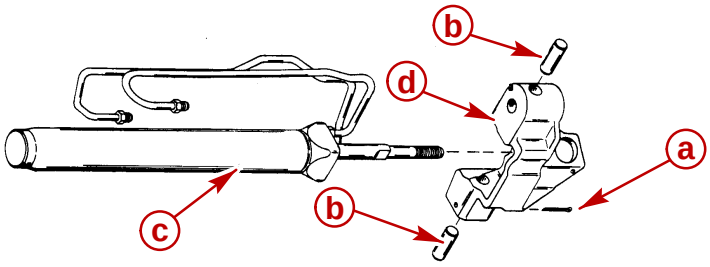
4. Remove clevis assembly.



22157

a - Clevis Assembly
b - Nut
c - Washer
d - Booster Cylinder

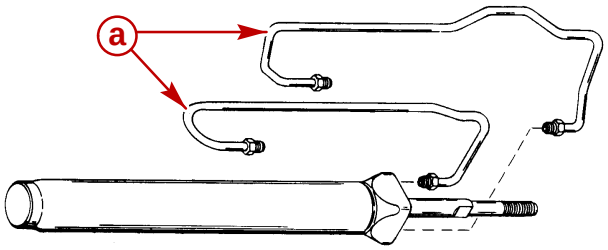
5. Separate booster cylinder from adaptor block assembly.



22158

a - Cotter Pin
b - Retaining Pins (2)
c - Booster Cylinder
d - Adaptor Block Assembly

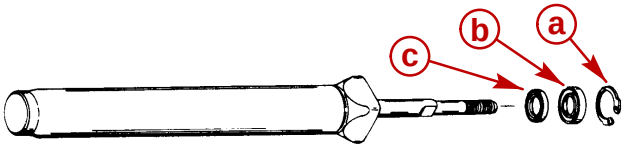
6. Remove lines from booster cylinder.



22157

a - Metal Lines

7. Remove components shown.

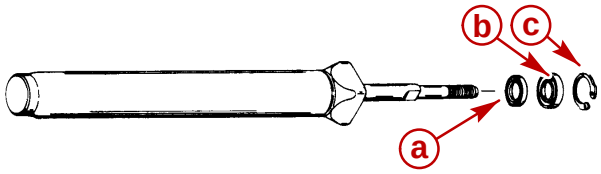


22149

a - Snap Ring
b - Large Oil Seal
c - Small Oil Seal

INSTALLATION

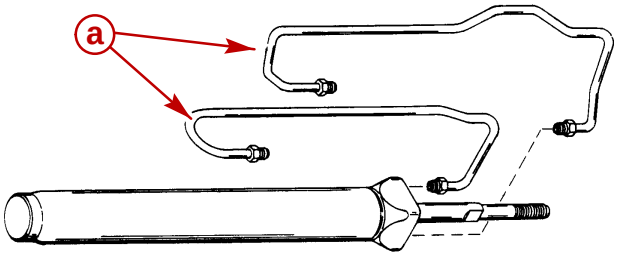
1. Install components shown.



22149

a - Small Oil Seal - Lip In
b - Large Oil Seal - Lip Out
c - Snap Ring - Install In Groove

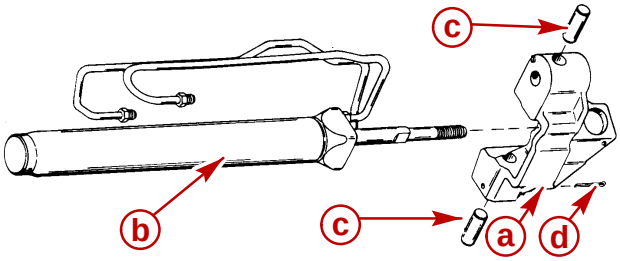
2. Install metal lines. Tighten Securely, BUT DO NOT OVERTIGHTEN



22157

a - Metal Lines

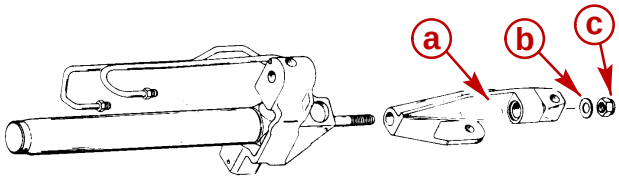
3. Install adaptor block assembly.



22158

a - Adaptor Block Assembly
b - Booster Cylinder
c - Retaining Pins
d - Cotter Pin - Spread Both Ends

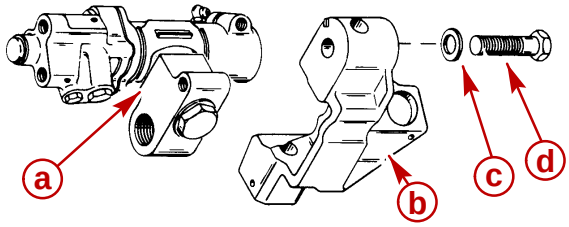
4. Install clevis assembly.



22157

a - Clevis Assembly
b - Washer
c - Nut - Tighten Securely

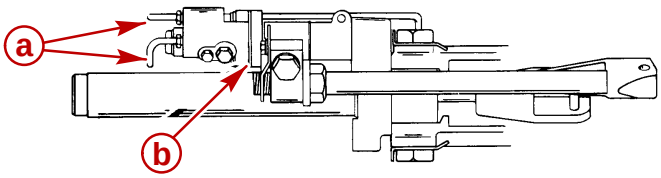
5. Secure control valve to adaptor block assembly. Torque to 30 lb-ft (40.5 Nm)



22143

a - Control Valve
b - Adaptor Block Assembly
c - Washer
d - Screw

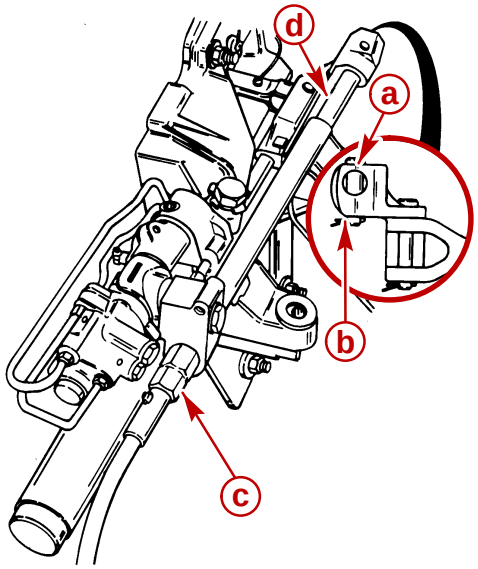
6. Install metal lines onto control valve. Tighten Securely BUT DO NOT OVER-TIGHTEN



22137

a - Metal Lines
b - Control Valve

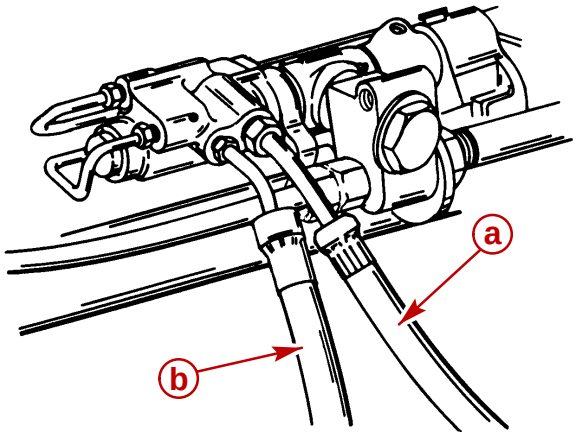
7. Apply a liberal amount of Special Lubricant 101 to end of steering cable and install cable end in clevis. Secure with pin and cotter pin.
8. Torque self-locking coupler nut to 35 lb-ft (48 Nm).



50927

a - Clevis Pin
b - Cotter Pin
c - Self-Locking Coupler Nut
d - Steering Cable

9. Connect power steering pump hoses to their respective fittings on control valve.
10. Torque large hose fitting to 23 lb-ft (30.5 Nm).
11. Torque the small hose fitting to 102 lb-in. (11.5 Nm).



50912

a - Hose (Large Fitting)
b - Hose (Small Fitting)

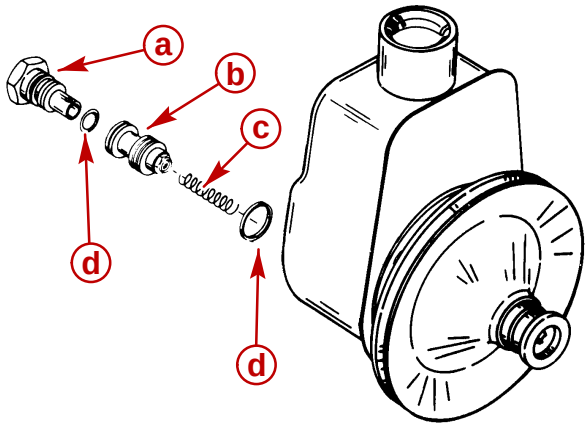
Power Steering Pump

Removal

1. Disconnect hoses at pump. Cap hose and fittings.
2. Loosen pump bolts at engine to remove pump belt.
3. Remove bracket from pump.

Flow Control Valve Servicing

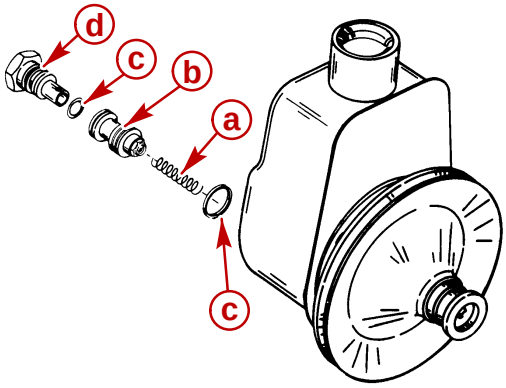
1. Drain fluid from pump.
2. Remove components shown.



22149

a - Fitting Assembly
b - Control Valve Assembly
c - Flow Control Spring
d - O-rings

3. Inspect control valve assembly and fitting assembly.
4. Install components shown.
5. Torque to 35 lb-ft (47 Nm).

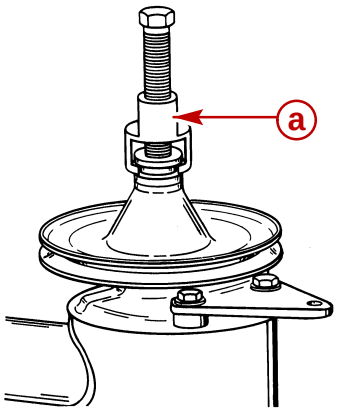


22149

a - Flow Control Spring
b - Control Valve Assembly
c - New O-rings
d - Fitting Assembly

Pump Shaft Oil Seal Replacement

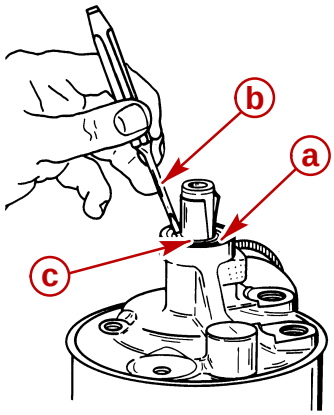
1. Remove pump pulley.



22149

a - Kent Moore Pulley Removal Tool (J-25034)

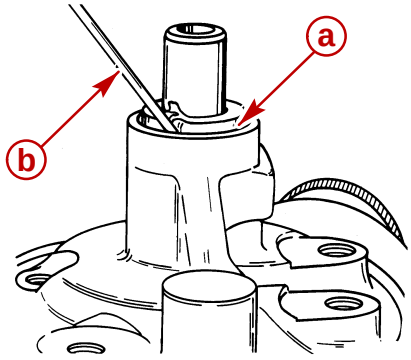
2. Push a .005 in. (0.13 mm) shim stock past oil seal until it bottoms in pump body (approximately 2-1/2 in. [64 mm] long).
3. Cut seal and tear metal body approximately 1 in. (25 mm).



22152

a - Oil Seal
b - Chisel - To Cut Seal
c - Shim Stock

4. Remove oil seal. Remove shim stock.

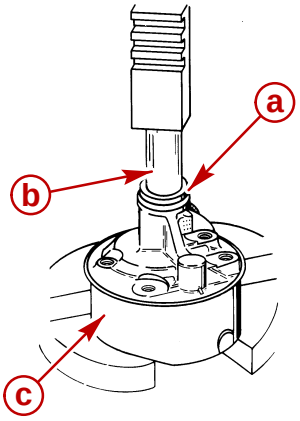


22152

a - Torn Seal
b - Awl

5. Install new oil seal.

NOTE: Properly Support so Reservoir Back Does Not Distort

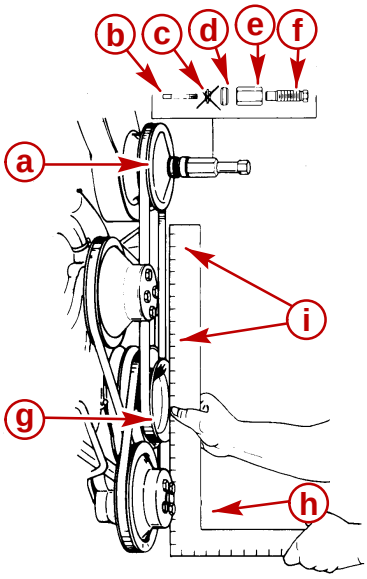


22151

a - New Oil Seal - Metal Side Up
b - 1 in. Socket
c - Pump Reservoir

6. Install pulley, as follows, using Pulley Pusher Assembly 91-93656A1, and a long straight edge:
   a. Place pulley on pump shaft.
   b. Thread stud ALL-THE-WAY into pump shaft. Place bearing over stud. DO NOT use spacer from kit.
   c. Thread nut onto shaft. Thread shaft (and nut) ALL-THE-WAY onto stud.
   d. Using a long straight edge (to check drive belt alignment), turn large pusher nut until drive belt is parallel to straight edge.

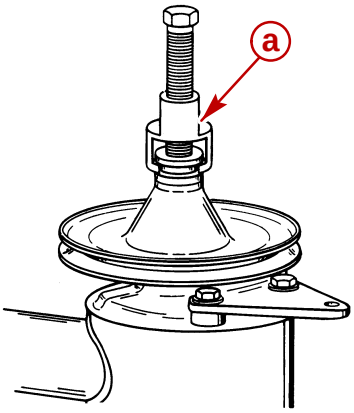
e. Check pulley installation for correct alignment.



a - Power Steering Pump Pulley
b - Stud
c - DO NOT Use Spacer
d - Bearing
e - Nut
f - Shaft
g - Crankshaft Pulley (Shown) or Water Circulating Pump Pulley
h - Long Straight Edge
i - Drive Belt Parallel

Disassembly

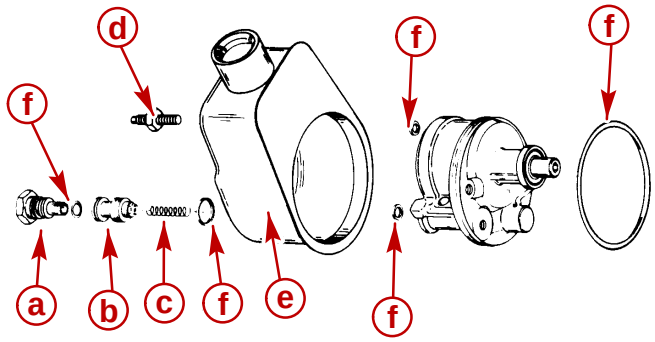
1. Drain fluid from pump.
2. Remove pump pulley.



22149

a - Kent Moore Pulley Removal Tool (J-25034)

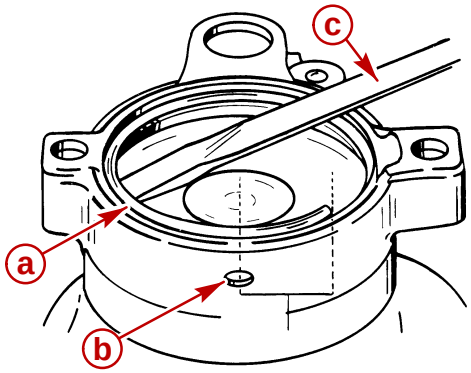
3. Remove reservoir.



22155

a - Fitting Assembly
b - Control Valve Assembly
c - Flow Control Spring
d - Studs
e - Reservoir
f - O-rings

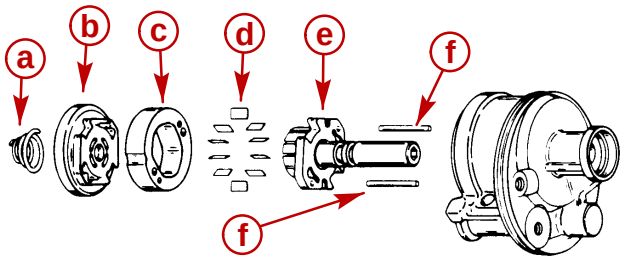
4. Remove retaining ring and end plate.



22150

a - Retaining Ring - Position so that Ring End is 1 in. (25 mm) from End of Hole in Housing
b - Hole
c - Screwdriver

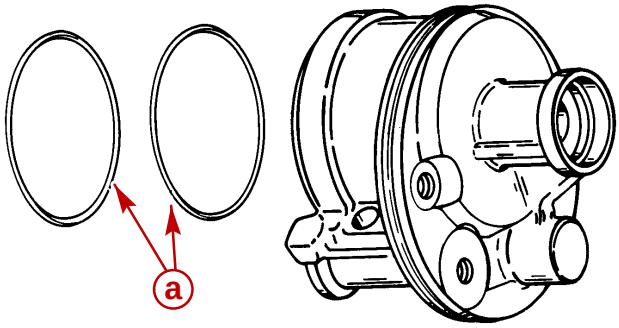
5. Remove pump components shown.



22155

a - Spring
b - Pressure Plate
c - Pump Ring
d - Pump Vanes
e - Pump Shaft and Rotor Assembly
f - Dowel Pins

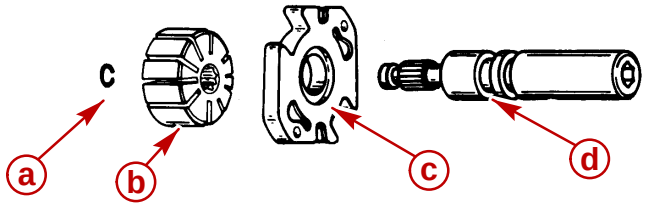
6. Remove and discard O-rings from housing.



22155

a - O-rings - Discard

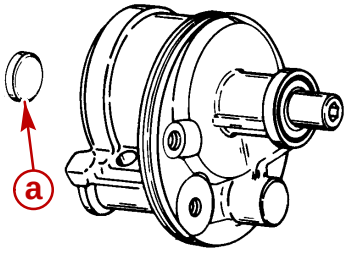
7. Remove rotor and thrust plate.



22155

a - Retaining Ring
b - Rotor
c - Thrust Plate
d - Pump Shaft

8. Remove magnet.



22154

a - Magnet

Cleaning And Inspection

1. Clean and inspect all metal parts.

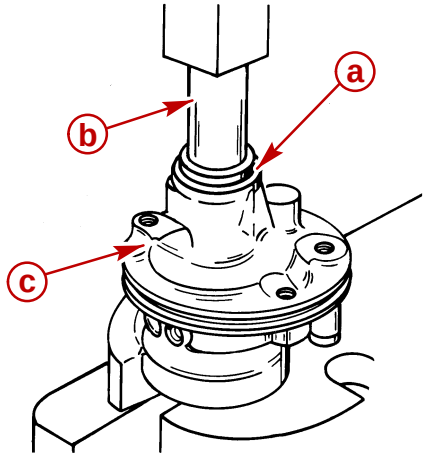
Reassembly

NOTE: *All references to Power Steering fluid refer to Quicksilver Power Trim and Steering Fluid, or Dexron II if Quicksilver product is not available.*

NOTE: *Obtain and install a new seal kit 5688044 from a local GM automotive dealer when reassembling pump.*

1. Install new pump shaft oil seal.

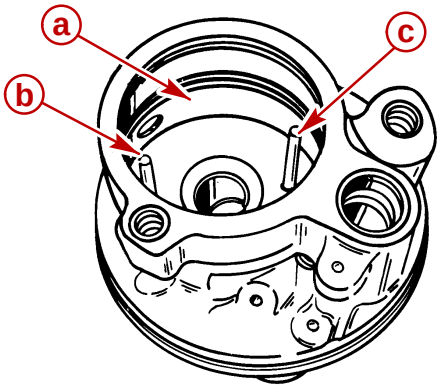
NOTE: *Properly support so the back of the reservoir does not distort.*



22151

a - New Oil Seal - Metal Side Up
b - 1 in. Socket
c - Pump Reservoir

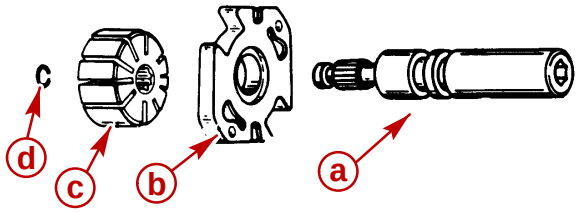
2. Install pressure plate O-ring and dowel pins.



22150

a - Pressure Plate O-ring - Lubricate with Power Steering Fluid; Place in Third Groove in Housing
b - Dowel Pins

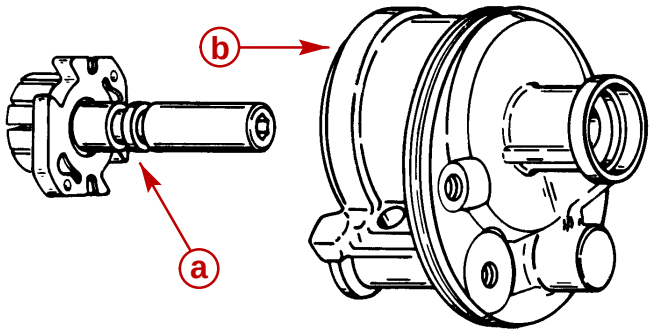
3. Assemble pump shaft and rotor assembly.



22155

a - Pump Shaft
b - Thrust Plate
c - Rotor - Countersunk Side Toward Thrust Plate
d - Retaining Ring

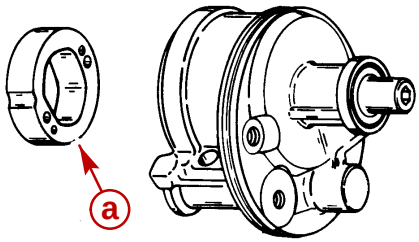
4. Install pump shaft and rotor assembly.



22154

a - Pump Shaft and Rotor Assembly
b - Pump Housing

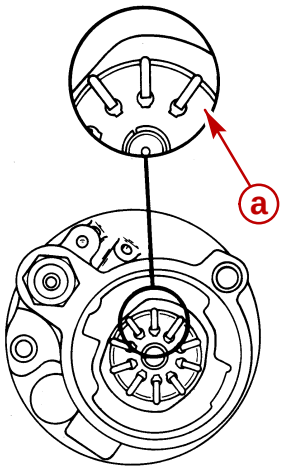
5. Install pump ring.



22154

a - Pump Ring - Place 2 Smaller Holes Over Dowel Pins

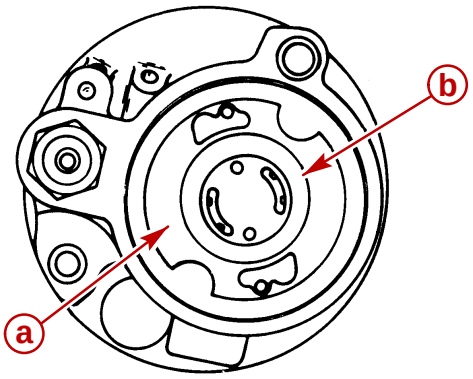
6. Install vanes in rotor slots - Rounded edges toward pump ring. Vanes must slide freely.



22154

a - Vanes - Rounded Edges Toward Pump Ring

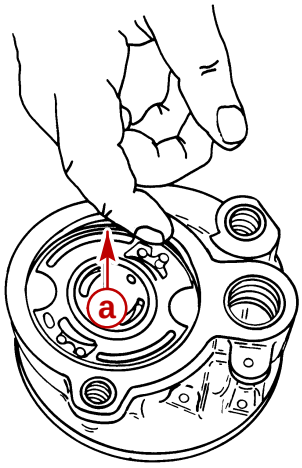
7. Install pressure plate.



22154

a - Pressure Plate
b - Spring Groove - Facing Up

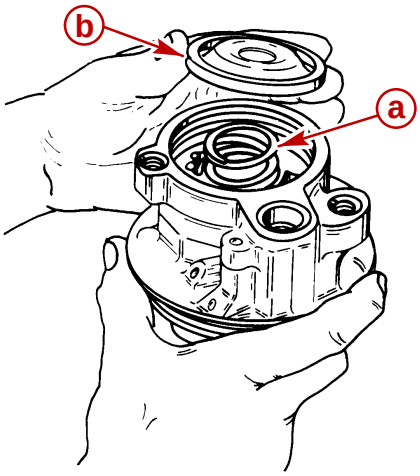
8. Install end plate O-ring.



22150

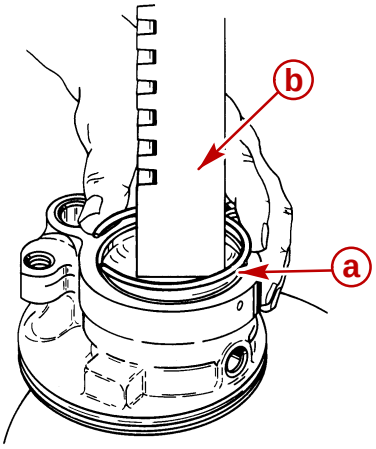
a - End Plate O-ring - Lubricate with Power Steering Fluid; Place in Second Groove in Housing

9. Install pressure plate spring, end plate and retaining ring.



22151

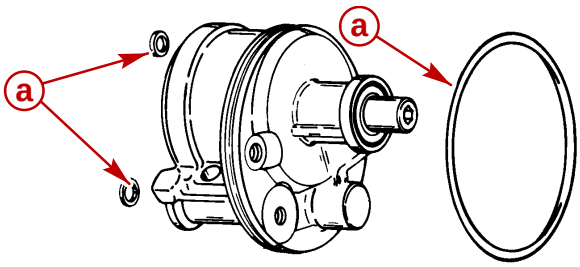
a - Pressure Plate Spring
b - End Plate



22152

a - Retaining Ring
b - Arbor Press -

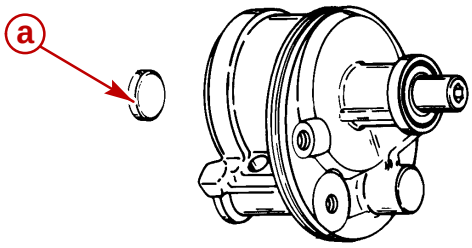
10. Install reservoir O-rings.



22153

a - Reservoir O-ring - Lubricate with Power Steering Fluid; Install in Groove in Pump Housing

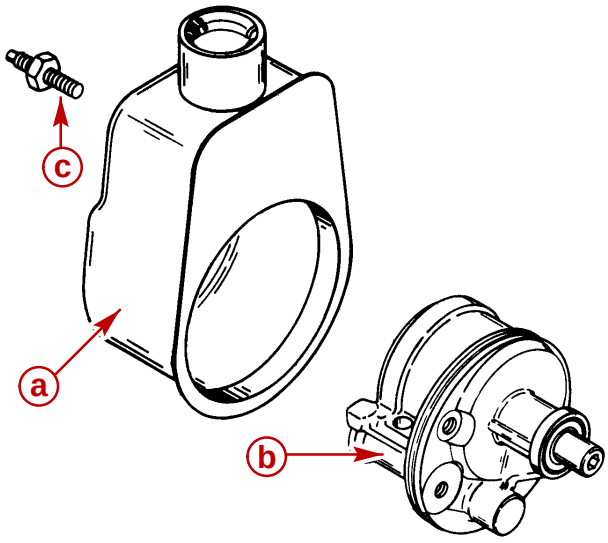
11. Place magnet on housing.



22153

a - Magnet

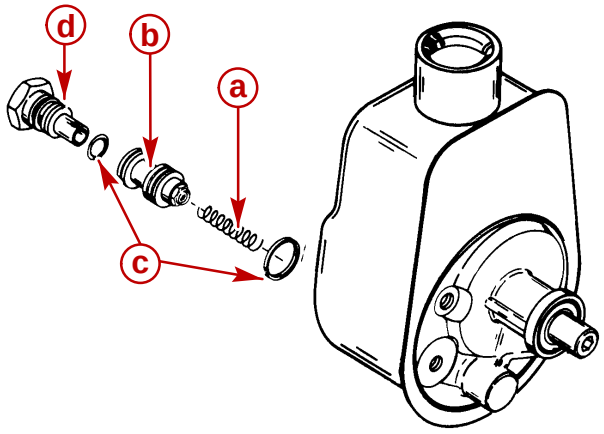
12. Secure reservoir to pump housing. Torque studs to 35 lb-ft (47 Nm).



22153

a - Reservoir
b - Pump Housing
c - Studs

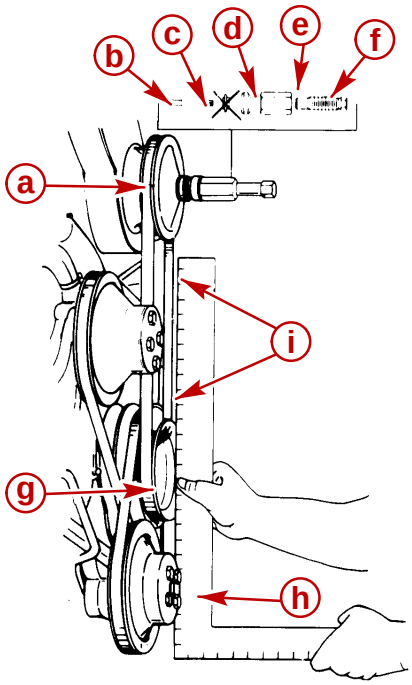
13. Install components shown. Torque fitting assembly to 35 lb-ft (47 Nm).



22153

a - Flow Control Spring
b - Control Valve Assembly
c - O-ring - for Fitting Assembly
d - Fitting Assembly

14. Install pulley, as follows, using Pulley Pusher Assembly 91-93656A1, and a long straight edge:
    a. Place pulley on pump shaft.
    b. Thread stud ALL-THE-WAY into pump shaft. Place bearing over stud. DO NOT use spacer from kit.
    c. Thread nut onto shaft. Thread shaft (and nut) ALL-THE-WAY onto stud.
    d. Using a long straight edge (to check drive belt alignment), turn large pusher nut until drive belt is parallel to straight edge.
    e. Check pulley installation for correct alignment.



a - Power Steering Pump Pulley
b - Stud
c - DO NOT Use Spacer
d - Bearing
e - Nut
f - Shaft
g - Crankshaft Pulley (Shown) or Water Circulating Pump Pulley
h - Long Straight Edge
i - Drive Belt Parallel

15. Install power steering pump on engine. (Refer to appropriate Engine Service Manual.)

Multiple Sterndrive Steering Tie Bar Arrangements

With multiple sterndrives it is important to consider which of several possible steering systems should be selected.

⚠ CAUTION

Failure to observe the recommended Tie Bar Arrangements as presented in this section could result in serious damage to the steering and/or trim system components. This damage could adversely affect control of the boat.

INTERNAL TIE BAR ONLY

At the lower end of the performance spectrum (boats not capable of speeds in excess of 60 MPH) the basic internal tie bar is recommended. It connects the slave sterndrive to the sterndrive that is directly connected to the factory power steering output. This internal tie bar is available in a variety of lengths from the sterndrive manufacturer.

INTERNAL AND EXTERNAL TIE BAR

As a boat moves into a moderate performance range (60-70 MPH) or for a reduction in steering backlash, an external tie bar should be added. External tie bars are usually designed to attach at the aft power trim cylinder bosses which is an excellent location because of its proximity to the propeller. HOWEVER, because of the potential overstress that can occur if one drive is trimmed much differently than the other, a dual trim control kit (Part Number 90362A3) should be installed so as to limit this potential tilt differential to about 20°.

EXTERNAL POWER STEERING

When boat speeds move past 70 MPH or if additional steering backlash reduction is desired, external power steering is recommended. This normally will include an external tie bar mounted at the same general location of the power steering cylinders which are generally attached at the top of the sterndrive's drive shaft housing. With this steering system, no internal tie bar should be used. These steering cylinders can be attached either inboard (between) or outboard of the sterndrives.

EXTERNAL POWER STEERING WITH LOW EXTERNAL TIE BAR

For the fastest boats (over 80 MPH) or for the ultimate in steering backlash reduction, use external power steering, BUT (where mechanically possible) with the external tie bar mounted at the trim cylinder boss location (as previously described in "Internal and External Tie Bar" statements). Again this system does not use an internal tie bar.

Mercury Marine does not recommend the use of an external tie bar ONLY (no internal tie bar) when using the internal power steering system. This can cause excessive loads on the steering components on the drive connected to the internal power steering system. These increased loads can damage the steering components, resulting in increased play in the steering of the boat.

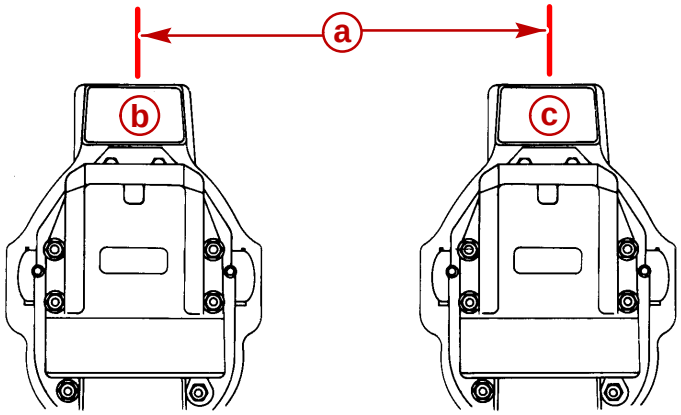
Determining Tie Bar Length

⚠ WARNING

ON DUAL INSTALLATION USING STARBOARD TIE BAR KIT. The steering cable MUST have a minimum radius of 8 in. (203 mm) at the transom end. A radius less than 8 in. (203 mm) may kink the steering cable which, in turn, may affect steering operation. If the minimum 8 in. (203 mm) requirement cannot be met due to boat construction, etc., steering cable must then be routed to port transom and a port transom and a port tie bar kit 96708A4, A5 or A6 MUST BE used in place of the starboard tie bar kit.

NOTE: *If drive units are to be "toed-in" or "toed-out," measure from centerlines of steering levers (with drive units positioned as desired), instead of centerlines of power packages. In most cases, the best boat handling and performance characteristics will be obtained with the drive units positioned parallel.*

1. Determine tie bar length.
   a. Measure centerline distance (Dimple in Gimbal Housing is located beneath the decal in the top center).
   b. Apply measurement to appropriate chart to determine tie bar length.



70133

a - Distance Between Centerlines
b - Port Transom Assembly Centerline
c - Starboard Transom Assembly Centerline

Selection

TIE BAR CHART For Dual Installations with Steering Cable Attached to Starboard Power Package	
* 16" to 30"	92020A1
* 30" to 46"	92020A2
46" to 62"	92020A3
* If centerline distance is the same as maximum figure, use next larger size tie bar.	

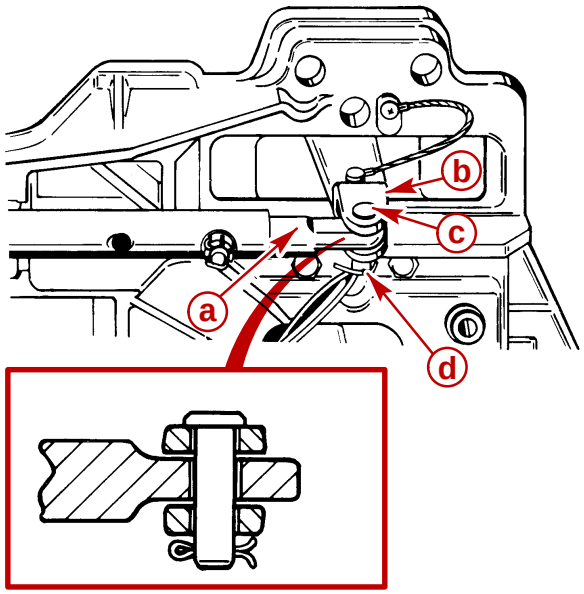
TIE BAR CHART For Dual Installations with Steering Cable Attached to Port Power Package	
* 28" to 37-1/2"	96708A4
* 37-1/2" to 55"	96708A5
55" to 72"	96708A6
* If centerline distance is the same as maximum figure, use next larger size tie bar.	

Installation

DUAL INSTALLATIONS WITH STEERING CABLE ATTACHED TO STARBOARD POWER PACKAGE

1. Install tie bar.

   a. Attach fixed bar end to steering lever, using clevis pin and cotter pin. Spread cotter pin ends.



22079

22211

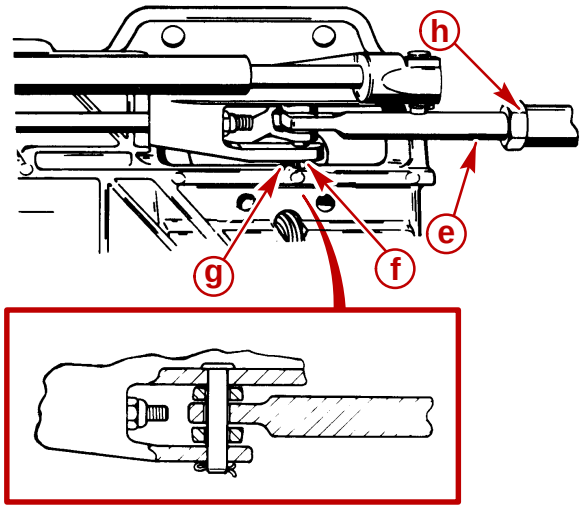
a - Fixed End
b - Steering Lever
c - Clevis Pin
d - Cotter Pin

   b. Position drive units as desired and turn adjustable end (if necessary) to align hole in bar with holes in steering lever and piston rod end clevis.

   c. Turn adjustable end out 3 to 4 turns from aligned position. Apply Loctite 8831 or equivalent, to exposed tie bar threads; then turn tie bar back in to previously aligned position.

   d. Attach tie bar end using clevis pin and cotter pin. Spread cotter pin ends.

e. Apply Loctite 8831 or equivalent, to exposed tie bar threads. Torque locknut to 40-60 lb-ft (54-81 Nm).



22079

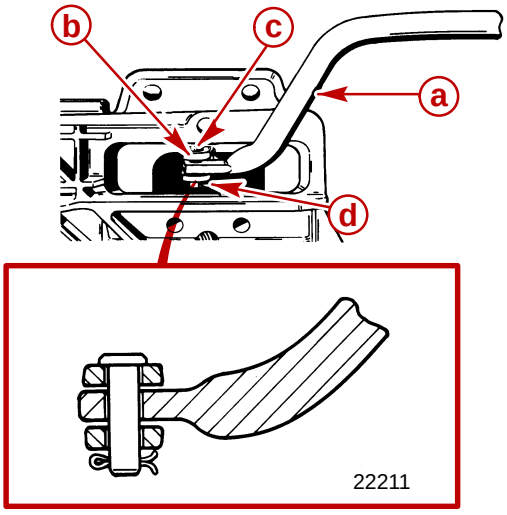
22211

e - Adjustable End
f - Clevis Pin
g - Cotter Pin
h - Locknut

DUAL INSTALLATIONS WITH STEERING CABLE ATTACHED TO PORT POWER PACKAGE

1. Install tie bar.

   a. Attach fixed bar end to steering lever, using clevis pin and cotter pin. Spread cotter pin ends.



22079

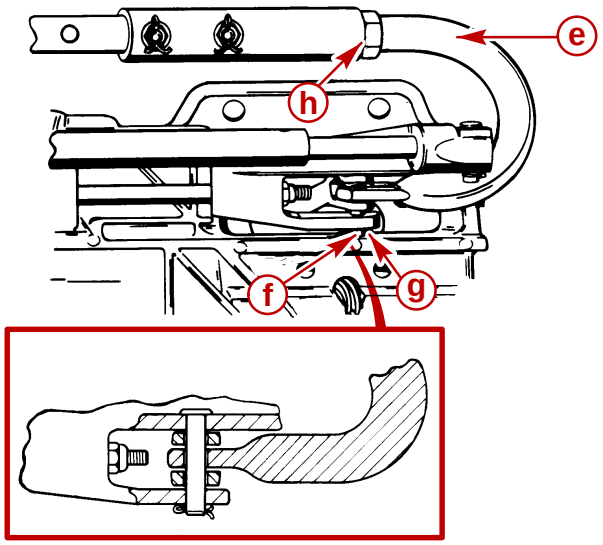
a - Fixed Bar End
b - Steering Lever
c - Clevis Pin
d - Cotter Pin

   b. Position drive units as desired and turn adjustable end (if necessary) to align hole in bar with holes in steering lever and piston rod end clevis.

c. Turn adjustable end out 3 to 4 turns from aligned position. Apply Loctite 8831 or equivalent, to exposed tie bar threads; then turn tie bar back in to previously aligned position.

d. Attach tie bar end using clevis pin and cotter pin. Spread cotter pin ends.

e. Apply Loctite 8831 or equivalent, to exposed tie bar threads. Torque locknut to 40-60 lb-ft (54-81 Nm).



22079

22211

e - Adjustable End
f - Clevis Pin
g - Cotter Pin
h - Locknut

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STEERING SYSTEM

Section 6B - Manual Steering

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6 B

Specifications

Torque Specifications

Description	Torque		
	lb-in.	lb-ft	Nm
Steering Cable Coupler Nut		35	48
Steering System Pivot Bolt		25	34
Steering Tub Nut		38	52

Lubricants/Sealers/Adhesives

Description	Part Number
Loctite 271	92-809820
Quicksilver 2-4-C Marine Lubricant with Teflon	92-825407A12
Special Lubricant 101	92-13872A1

Steering Cable Selection, Removal and Installation

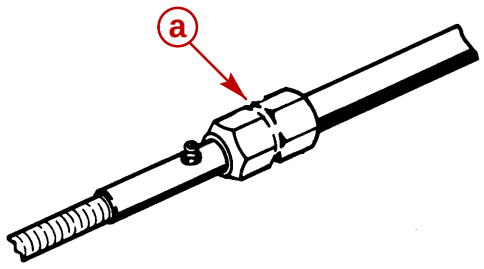
Selection

Transom assembly is shipped with the steering cable guide tube preset for cables with end dimensions that comply with ABYC standards as outlined in the NMMA certification handbook. The steering cable coupler nut must also have a means of locking it to the guide tube, as specified in ABYC requirements.

⚠ WARNING

Failure to use a steering cable locking device could cause loss of steering, which could cause damage to boat and/or injury.

All current production Quicksilver Ride Guide steering cables have a self-locking coupler nut and do not require an external locking device. (Other cable manufacturers also make cables with self-locking coupler nut.)

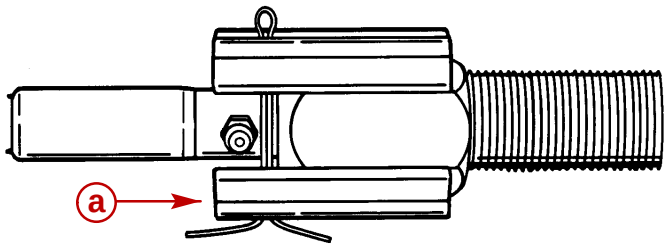


22060

a - Quicksilver Ride Guide Steering Cable Self-locking Coupler Nut (Identified By Groove)

If using a steering cable that does not have a self-locking coupler nut, an external locking device must be used.

Manual Steering Models



50627

a - Locking Sleeve Kit 71669A1

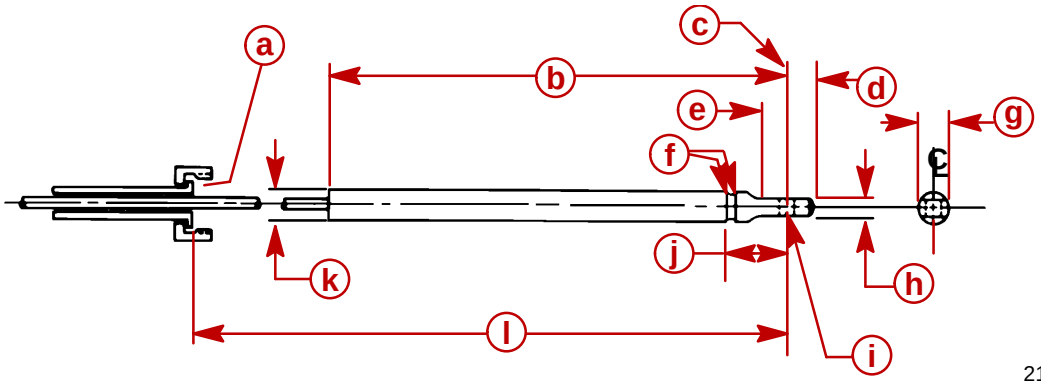
1. Steering cable must be the correct length, particularly when installed in larger boats.
2. Avoid sharp bends, kinks or loops in cable.

⚠ CAUTION

Steering cables MUST BE THE CORRECT LENGTH, particularly when installed in large boats. Sharp bends or too-short cables result in kinks; too-long cables require unnecessary bends and/or loops. Both place an extra stress on the cable. The proper cable is as short as possible, with the fewest bends and with radii as large as possible.

⚠ CAUTION

If cables with improper dimensions are installed, severe damage to the transom and/or steering system may result.

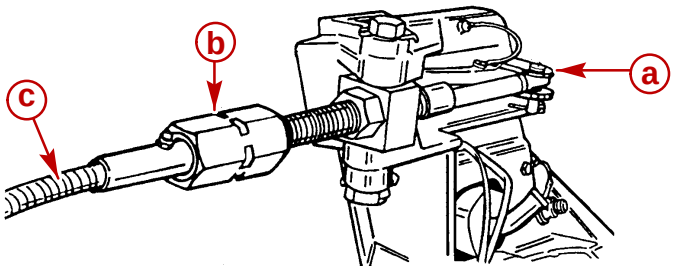


21435

a - Coupler Nut - 7/8 - 14 UNF - 2B Thread
b - 11-3/4 in. (298 mm) Min.
c - Interface Point
d - 1/2 in. (12.7 mm) Max.
e - 27/64 in. (10.7 mm) Min. Flat
f - 7/64 in. (3.1 mm) Min. Radius
g - 5/8 in. (15.9 mm) Max. Diameter End Fitting
h - 3/8 in. (9.5 mm)
i - 3/8 in. (9.8 mm) Diameter Thru Hole, Chamfered Each Side
j - 1-3/8 in. (34.9 mm) Max.
k - 5/8 in. (15.9 mm) Diameter Tube
l - Cable Travel:
-Mid-Travel Position - 16-7/8 in. (428.6 mm).
-Total Travel To Be 8 in. (203.2 mm) Min., to 9 in. (228.6 mm) Max.
-Travel Each Side of Mid-Travel Position - 4 in. (101.6 mm) Min., 4-1/2 in. (114.3 mm) Max.

Removal

1. Remove steering cable.



70373

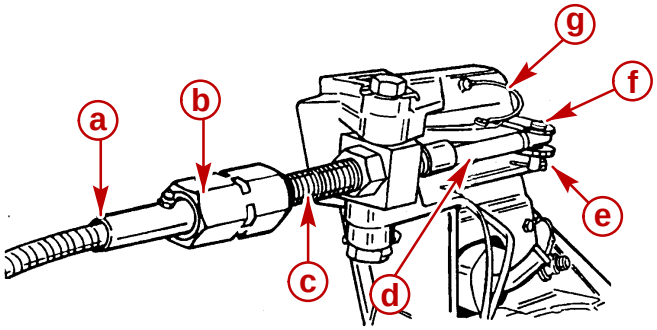
a - Clevis Pin - Remove
b - Cable Coupler Nut - Unthread
c - Steering Cable

Installation

1. Liberally coat steering cable end with Special Lubricant 101 and install cable.

⚠ WARNING

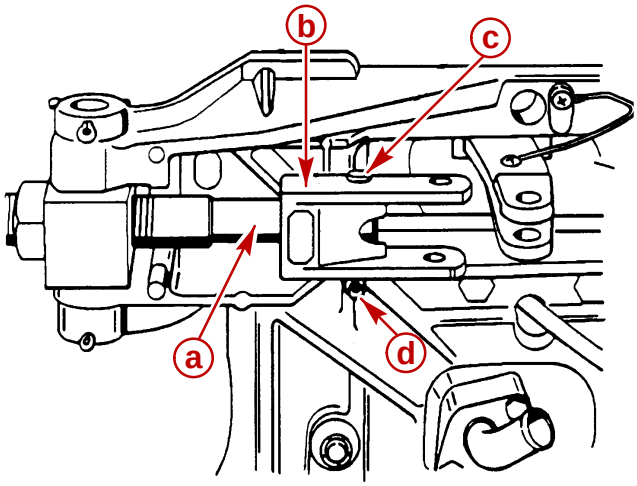
Steering cable outer casing MUST BE free to move back and forth for steering to function properly. DO NOT fasten wires, cables or other items to the steering cable, as this may prevent it from moving.



70373

a - Steering Cable
b - Cable Coupler Nut
c - Steering Cable Guide Tube
d - Steering Cable End
e - Cotter Pin
f - Clevis Pin
g - Steering Lever

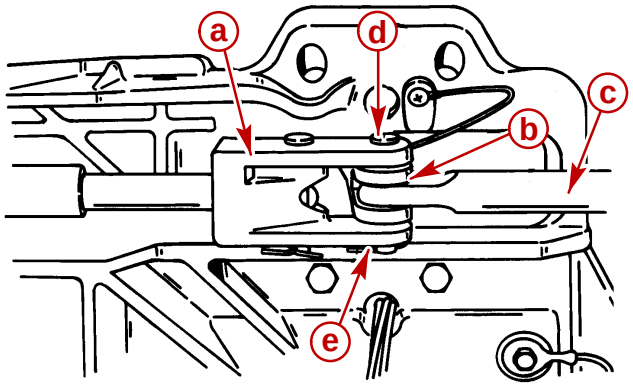
NOTE: *On dual installations only, secure clevis assembly to steering cable end.*



70743

a - Steering Cable End
b - Clevis Assembly
c - Clevis Pin
d - Cotter Pin

2. Connect clevis to steering lever and tie bar.



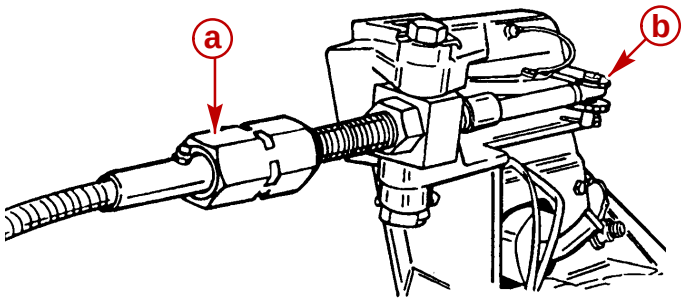
50483

a - Clevis Assembly
b - Steering Lever
c - Tie Bar
d - Clevis Pin
e - Cotter Pin

Manual Steering Swivel Ring Component Repair

Removal

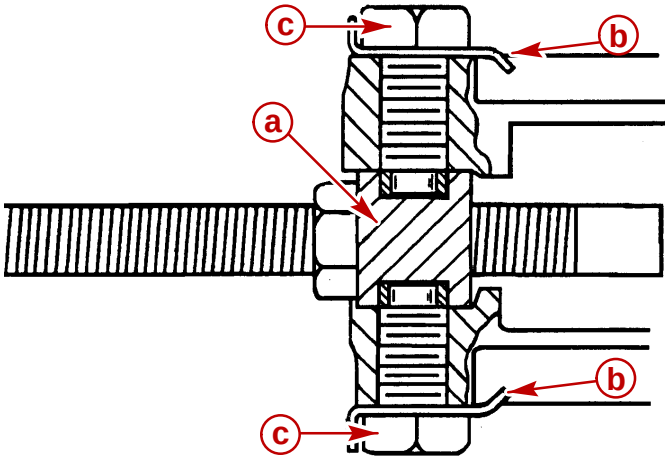
1. Remove steering cable.



70373

a - Clevis Pin
b - Cable Coupler Nut

2. Remove manual steering swivel ring.



70364

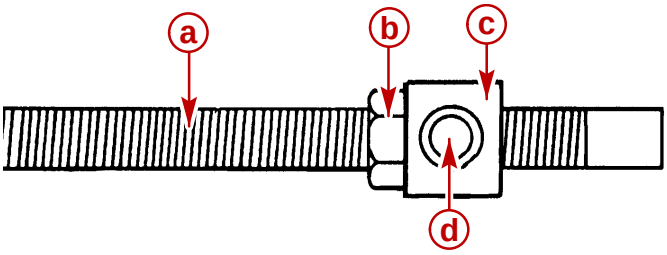
a - Swivel Ring
b - Tab Washer
c - Pivot Bolt

Disassembly

⚠ CAUTION

DO NOT apply source of heat (i.e. heat lamp, etc.) directly to swivel ring bushings as damage to bushings may result.

1. Remove components shown. Heat may need to be applied to the nut to loosen the Loctite 271.



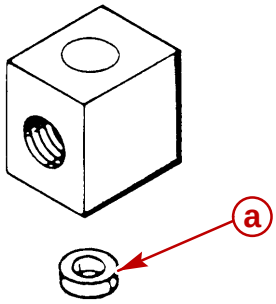
70368

Manual Steering Swivel Ring Components

- **a** - Guide Tube
- **b** - Nut
- **c** - Swivel Ring
- **d** - Bushings

Reassembly

1. Install bushings.

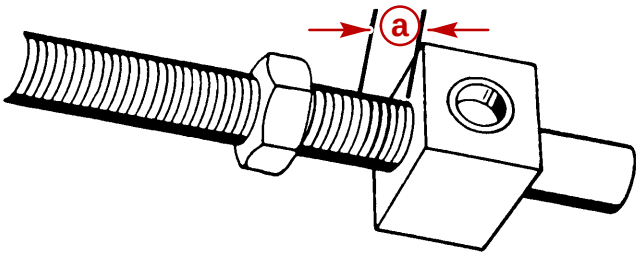


- **a** - Bushings - Press into Swivel Ring

⚠ WARNING

Loctite MUST BE applied to cable guide tube threads to prevent tube from loosening during operation.

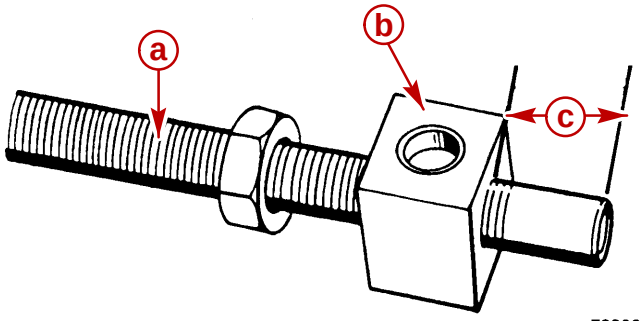
2. Clean guide tube threads with a wire brush to remove old Loctite. Apply a liberal amount of Loctite 271 to guide tube threads (in area where swivel ring and locknut will be installed).



70365

a - Loctite 271

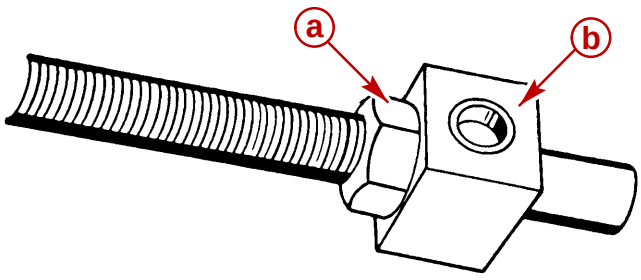
3. Turn swivel ring to obtain dimension shown.



70366

a - Cable Guide Tube
b - Swivel Ring
c - 2-1/2 in. ± 1/8 in. (64 mm ± 3 mm)

4. Tighten nut and washer against swivel ring. Torque to 37.5 lb-ft (50.5 Nm).



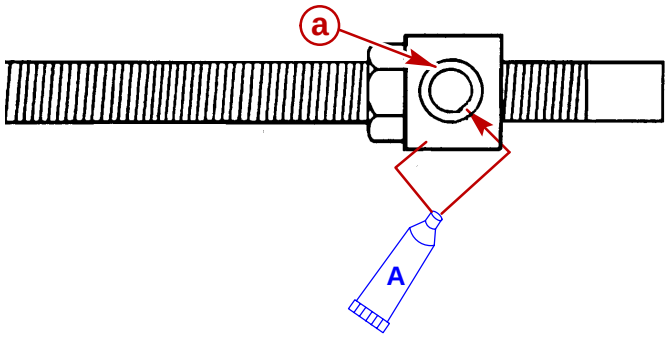
70367

a - Nut
b - Swivel Ring

Installation

Manual steering swivel rings secured with pivot bolts.

1. Lubricate swivel ring bushings.

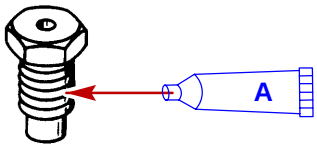


70368

a - Bushings

A - Special Lubricant 101

2. Lubricate pivot bolts.

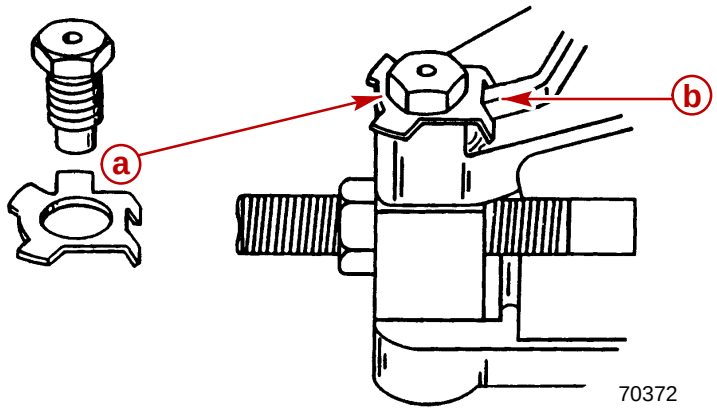


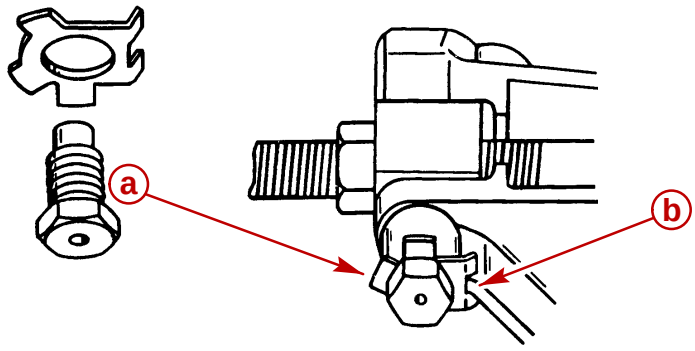
22944

a - Pivot Bolt

A - Special Lubricant 101

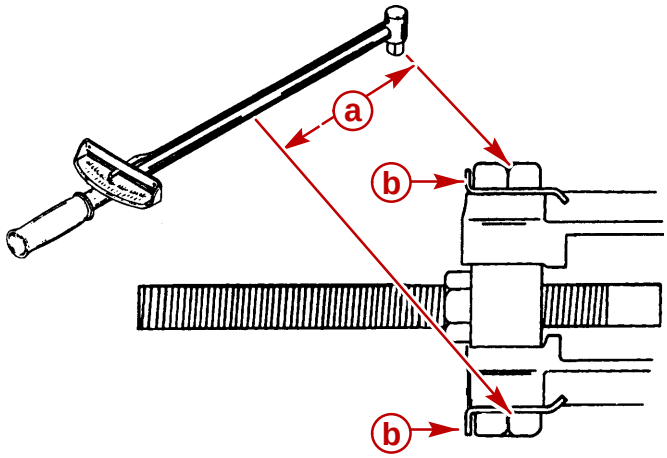
3. HAND THREAD pivot bolts all the way into inner transom plate and swivel ring. DO NOT use a wrench. Straddle tab washer tangs on inner transom plate ridge.





a - Pivot Bolts
b - Tab Washer
c - Swivel Ring

4. Torque bolts to 25 lb-ft (35 Nm). Bend washer tabs against corresponding flats on bolt.



a - Pivot Bolts
b - Washer Tabs

5. Move swivel ring back-and-forth to ensure that it pivots freely.

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CORROSION PROTECTION

Section 7A - All Models

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7 A

Specifications

Special Tools

Description	Part Number
MerCathode Reference Electrode Test	91-76675T1
Quicksilver VOA Meter*	91-93572

*If you do not already have this meter, use a digital multi-meter (such as Radio Shack 22-191). DO NOT use a standard analog (Needle-Type) Meter as inaccurate readings will result.

IMPORTANT: Quicksilver Volt/Ohm Meter 91-93572 and Multi-Meter DVA/Tester 91-99750 are no longer recommended for testing corrosion protection.

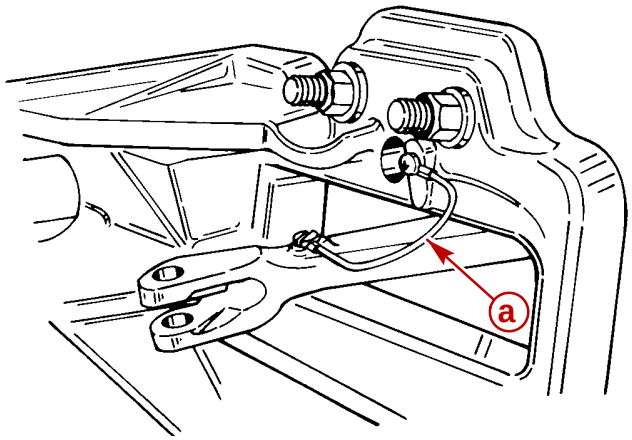
Lubricants/Sealers/Adhesives

Description	Part Number
Quicksilver Liquid Neoprene	92-25711-3

Continuity Circuit

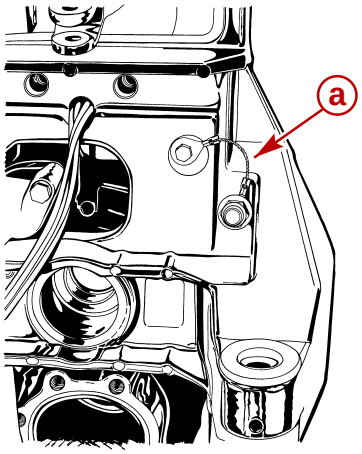
Transom assembly and sterndrive unit are equipped with ground circuit wires to ensure good electrical continuity between engine, transom assembly, and sterndrive components. Good continuity is essential for the zinc trim tab and MerCathode System to function effectively.

Inspect the following ground circuit components, at scheduled intervals (Section 1B), for loose connections, broken or fraying wires.

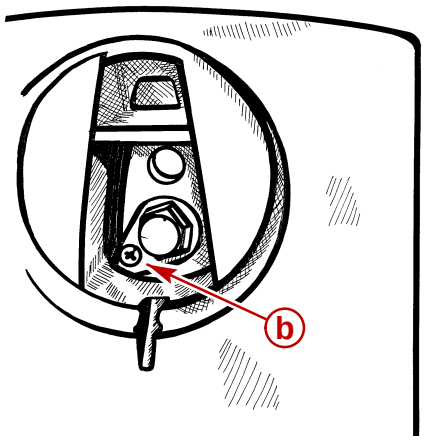


22028

a - Steering Lever Ground Wire

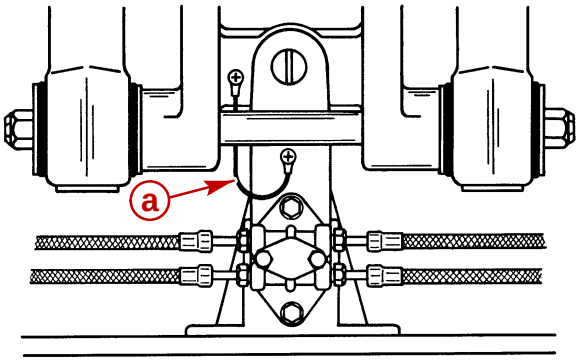


22650



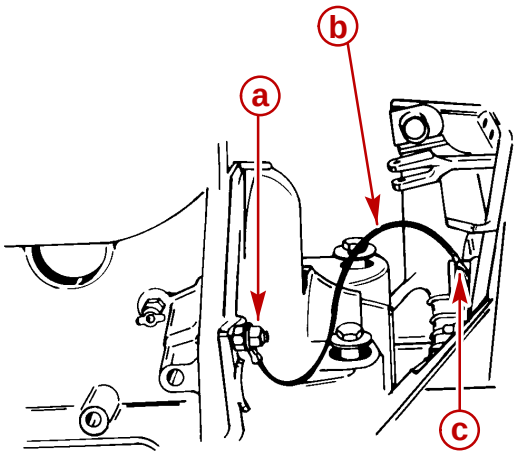
22754

a - Inner Transom Plate to Gimbal Housing Ground Wire
b - Driveshaft Housing to Gear Housing Ground Plate (Inside Trim Tab Cavity)

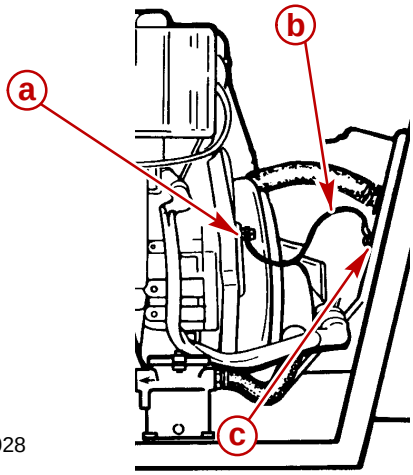


22230

a - Gimbal Housing to Gimbal Ring Ground Wire



22028

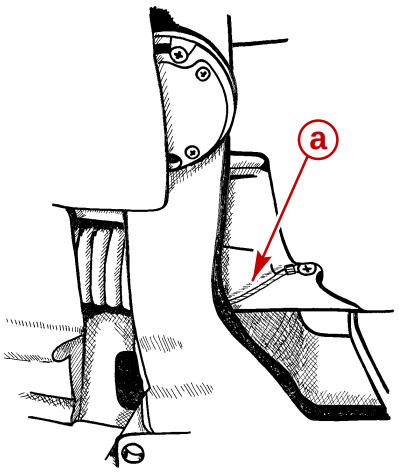


50242

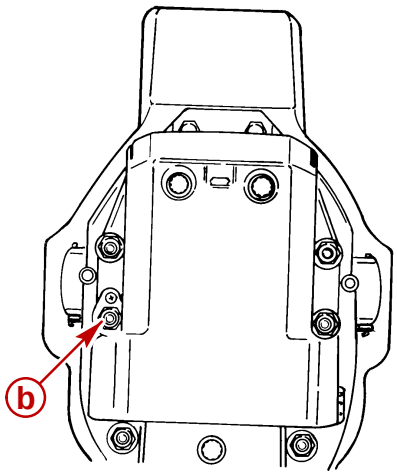
Gasoline Models **Diesel Models**

a - Flywheel Housing Grounding Stud
b - Ground Wire
c - Inner Transom Plate Grounding Screw

IMPORTANT: Do Not Ground any accessories at the Transom Plate Grounding Screw.

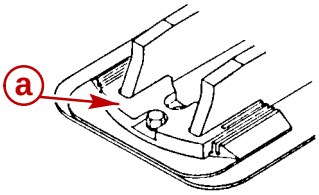


22755

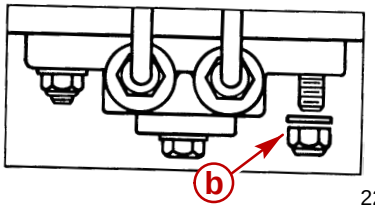


22031

a - Gimbal Ring To Bell Housing Ground Wire
b - Drive Unit To Bell Housing Ground Plate

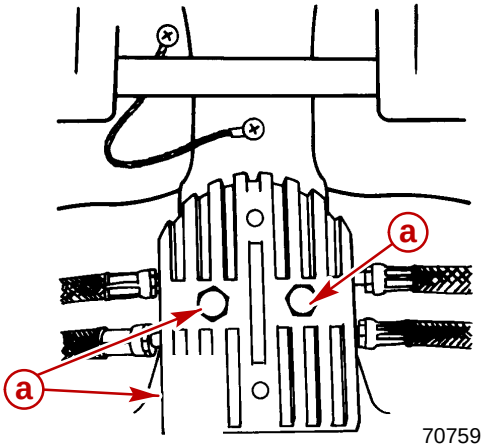


70575



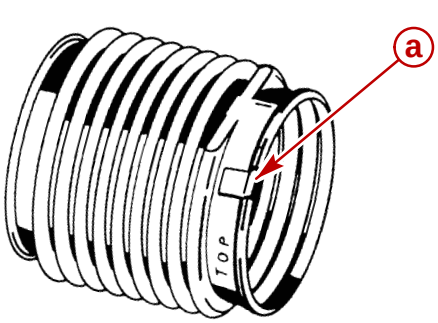
22230

a - Driveshaft Housing To Gear Housing Anodic Plate
b - Hydraulic Connector Block To Gimbal Housing Ground Washer

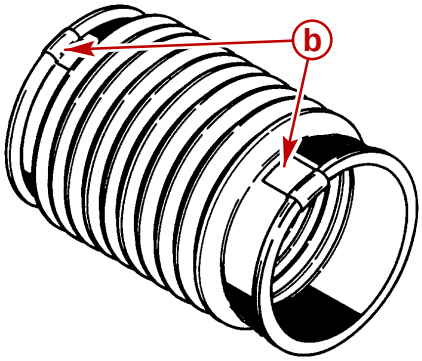


70759

a - Anodic Block To Hydraulic Manifold And Ground Washers (Beneath Screws).



50383



22079

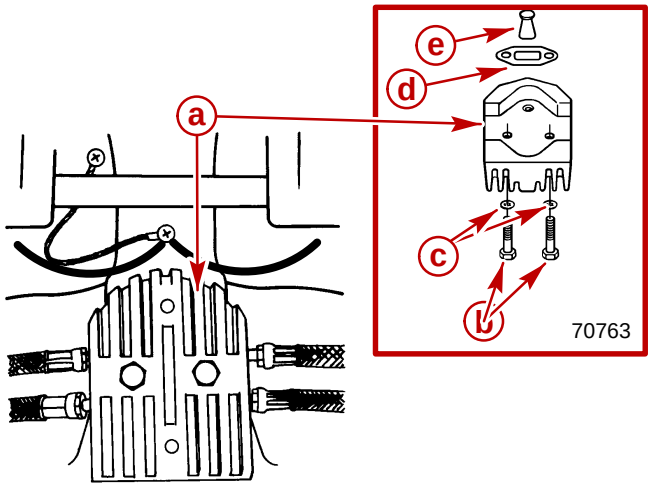
a - U-joint Bellows Ground Clip
b - Exhaust Bellows Ground Clips

Anodic Block

⚠ CAUTION

DO NOT paint new anodic block as this will render it ineffective as a galvanic corrosion inhibitor.

1. Remove screws, ground washers and gasket from anodic block. Remove anodic block to hydraulic manifold gasket and discard.

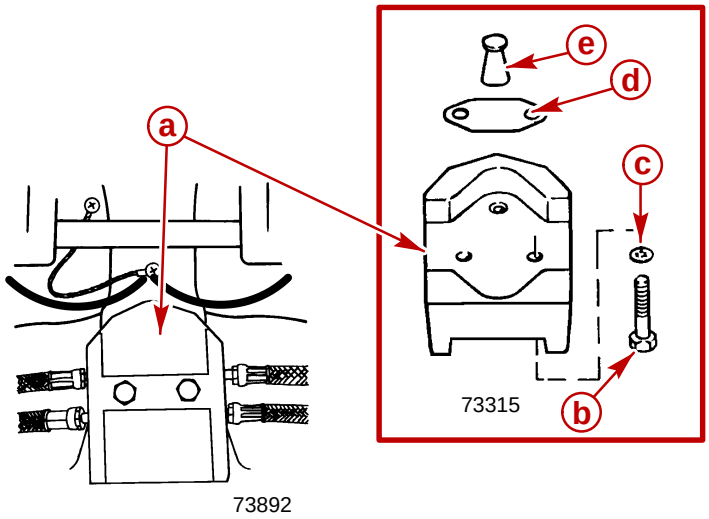


70763

70759

Earlier Style Anodic Block

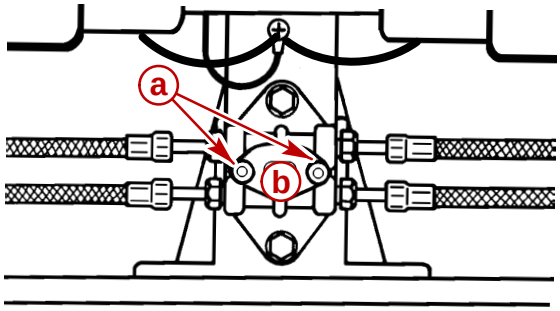
a - Anodic Block
b - Screws
c - Continuity Washers
d - Gasket
e - Seal



Later Style Anodic Block

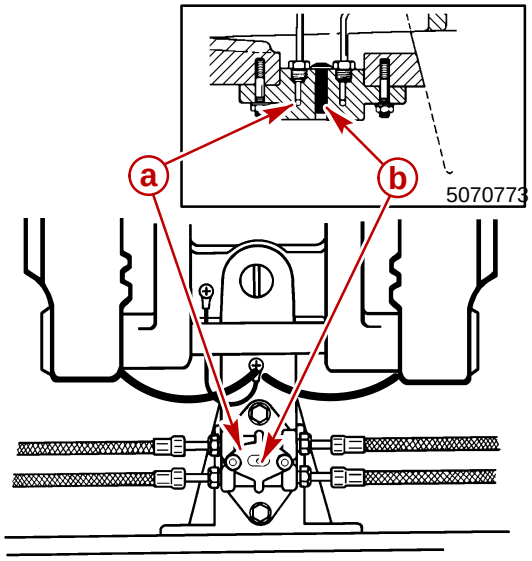
a - Anodic Block
b - Screw
c - Continuity Washer
d - Gasket
e - Seal

2. Check condition of hydraulic manifold and clean any debris from threaded holes.



a - Threaded Holes
b - Hydraulic Manifold

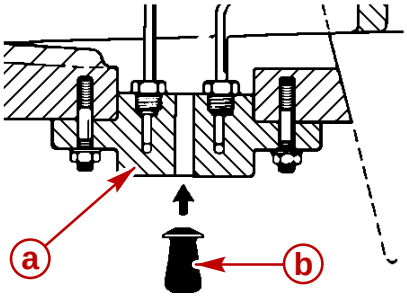
3. Examine rubber seal inside of hydraulic manifold block for signs of leakage or wear. Replace if necessary.



70748

a - Hydraulic Manifold
b - Rubber Seal

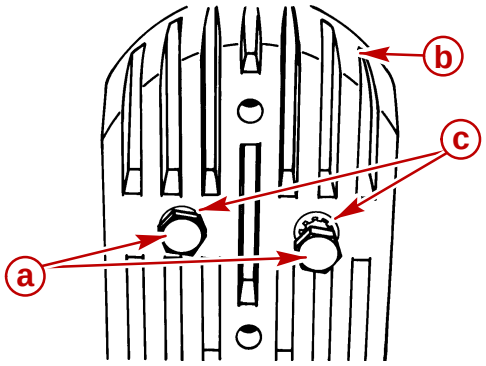
4. If rubber seal needs replacement, push old seal out of hydraulic manifold and install new seal as shown.



70774

a - Hydraulic Manifold
b - Rubber Seal

5. Install screws and washers into block as shown.



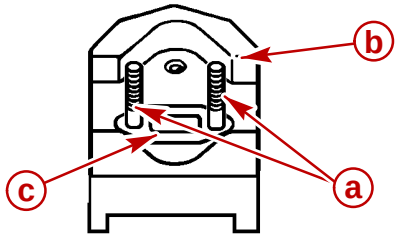
70760

a - Screws (2)
b - Anodic Block
c - Continuity Washers (2)

⚠ CAUTION

To be effective, new anodic block MUST make good continuity contact with gimbal housing.

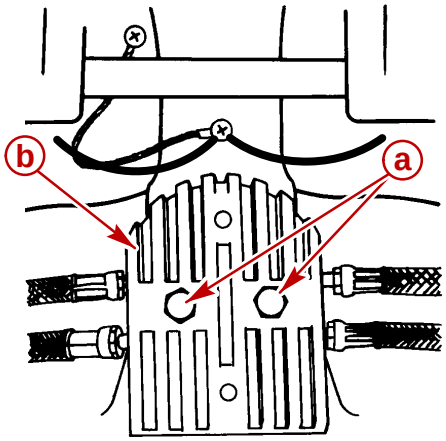
6. Be sure new gasket is in proper position between anodic block and hydraulic manifold. Apply Quicksilver Perfect Seal to threads of screw once they are through block.



70772

a - Screws (2)
b - Anodic Block
c - Gasket

7. Snug both screws evenly into hydraulic manifold, then torque to 100 lb-in. (11.5 Nm).



70759

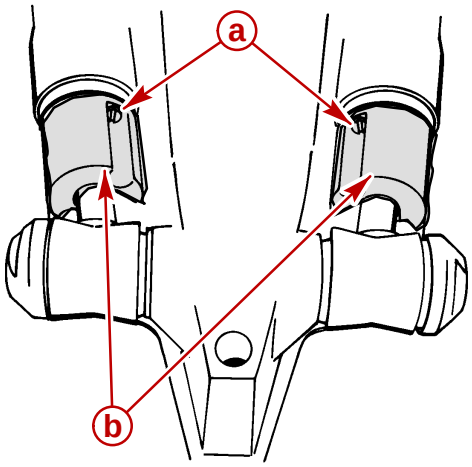
a - Screws and Washers
b - Anodic Block

Trim Cylinder Anodes

⚠ CAUTION

DO NOT paint new trim cylinder anodes, as this will render them ineffective as a galvanic corrosion inhibitor.

1. Remove screws that secure anodes to trim cylinders. Remove anodes.



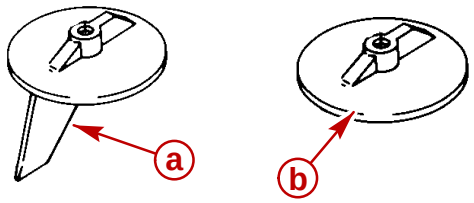
71966

a - Screws
b - Trim Cylinder Anodes

2. Scrape mounting surface on cylinder end-cap down to bare metal.
3. Install new anodes and tighten securely.

Anodic Trim Tab or Plate

NOTE: *Later models are equipped with an anodic plate instead of trim tab. Replacement procedure is the same.*



75251

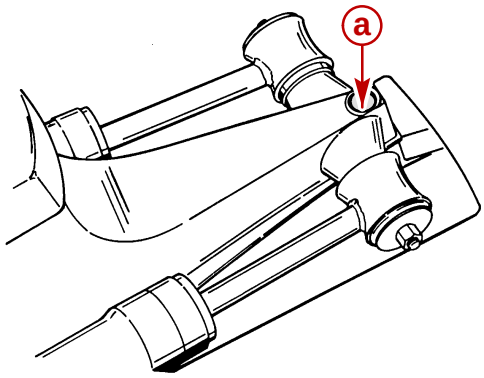
a - Trim Tab
b - Anodic Plate

⚠ CAUTION

DO NOT paint new trim tab (or anodic plate), as this will render it ineffective as a galvanic corrosion inhibitor.

Replacement

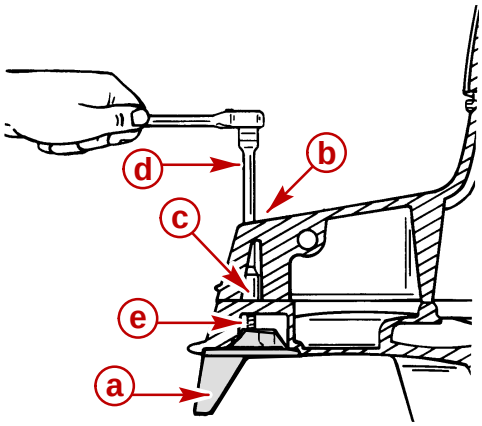
1. Remove plug from driveshaft housing to gain access to attaching screw.



22093

a - Plug

2. Use a 1/2 in. standard socket and extension, loosen screw, and remove trim tab (or anodic plate).



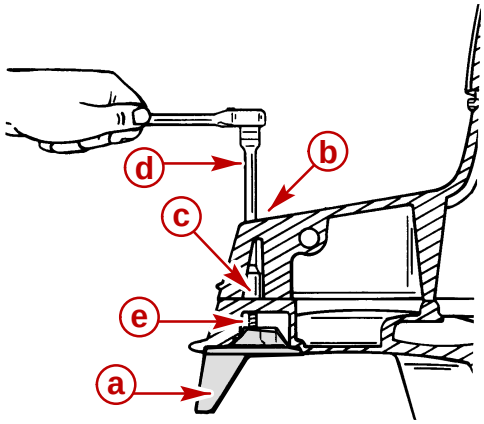
22258

a - Trim Tab (Or Anodic Plate, Depending Upon Model)
b - Plug - (Removed)
c - 1/2 in. Socket
d - Extension
e - Screw

⚠ CAUTION

To be effective, new trim tab (or anodic plate) MUST make good electrical contact with gear housing.

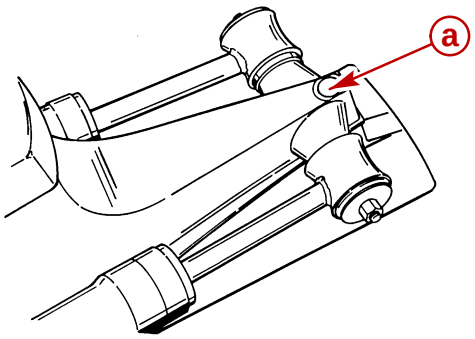
3. Scrape trim tab (or anodic plate) mounting surface on gear housing down to bare metal.
4. Install trim tab and align straight back. Torque screw to 30 lb-ft (40.5 Nm).



22258

a - Trim Tab (Or Anodic Plate, Depending Upon Model)
b - Plug - (Removed)
c - 1/2 in. Socket
d - Extension
e - Screw

5. Reinstall plug in driveshaft housing.

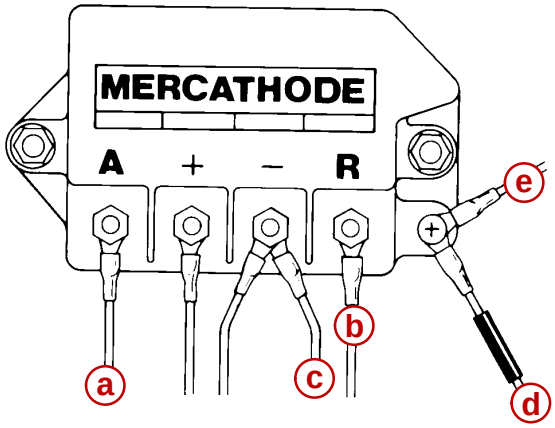


22093

Integral MerCathode System

Removing Electrode Assembly

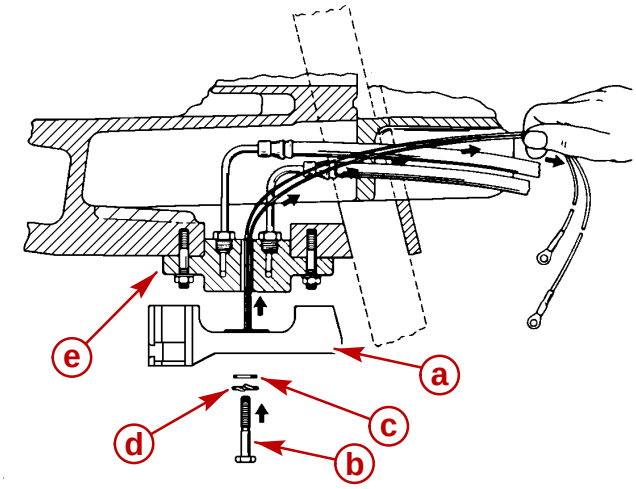
1. Disconnect electrode assembly wires from MerCathode Controller.



22032

a - Electrode Assembly Wire (Orange)
b - Electrode Assembly Wire (Brown)
c - Earlier Models - Trim Position Sender Wire (Black)
d - Earlier Models - Trim Position Sender Wire (Black)
e - Earlier Models - Wire to Trim Position Gauge (Brown/White)

2. Remove two screws, flat washers and lock washers; then remove electrode assembly.



70771

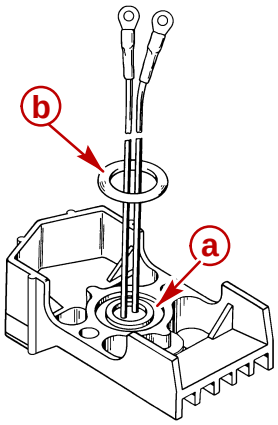
a - Electrode Assembly
b - Screw (2)
c - Flat Washer (2)
d - Lock Washer (2)
e - Hydraulic Connector Block

Installing Electrode Assembly

⚠ CAUTION

O-ring MUST BE properly seated in groove of electrode assembly or water leakage into boat will result.

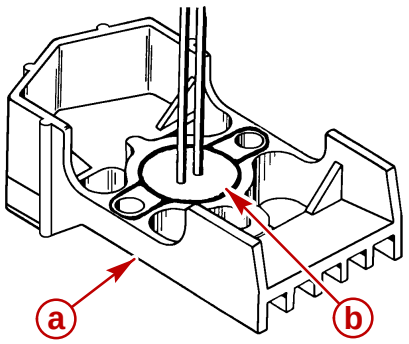
1. **Earlier Model Electrodes:** Install the O-ring over the orange and brown wires from the electrode assembly. Seat the O-ring in the groove. DO NOT use any type of sealer on the O-ring.



70756

a - O-ring Groove
b - O-ring

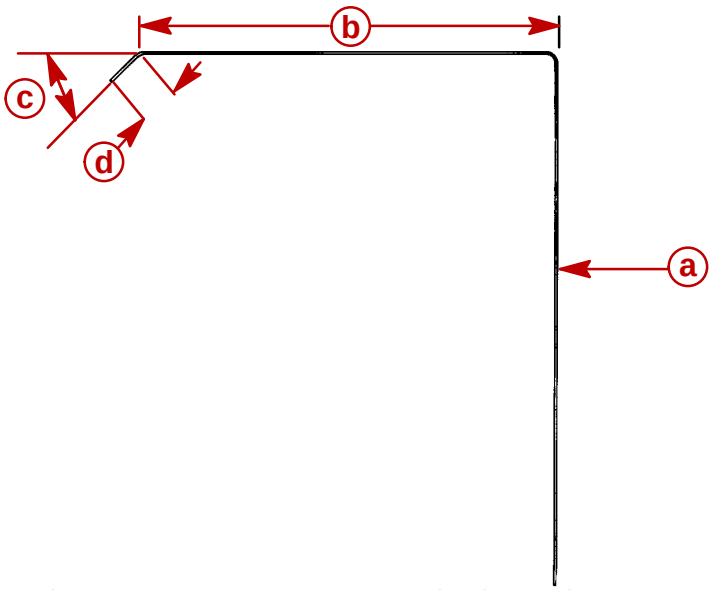
2. **Later Model Electrodes:** Later model electrodes have a factory installed rubber grommet and DO NOT require an O-ring.



71862

a - Electrode
b - Rubber Grommet

3. Form a 2 ft. (610mm) long piece of approximately .032 in. diameter wire to the dimensions shown.

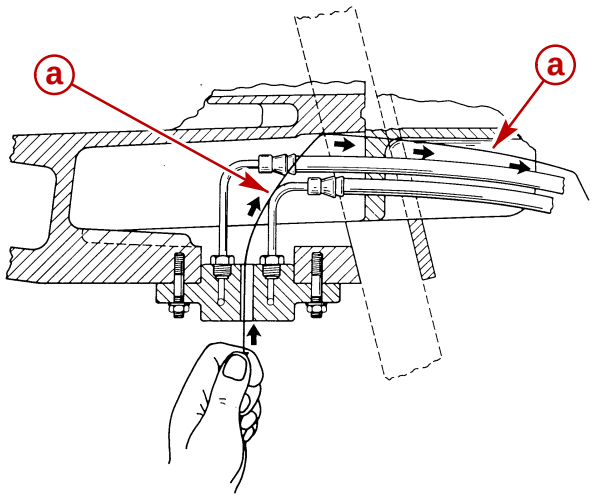


74106

a - 2 ft. (610 mm) OF APPROXIMATELY .032 in. (.8 mm) DIA. WIRE
b - 5 in. (123 mm)
c - 45° Angle
d - 1/2 in. (13 mm)

4. Insert 45° angle end of wire through center hole in hydraulic connector block.

5. Guide wire through hole until wire protrudes through cavity on the bottom of exhaust pipe.



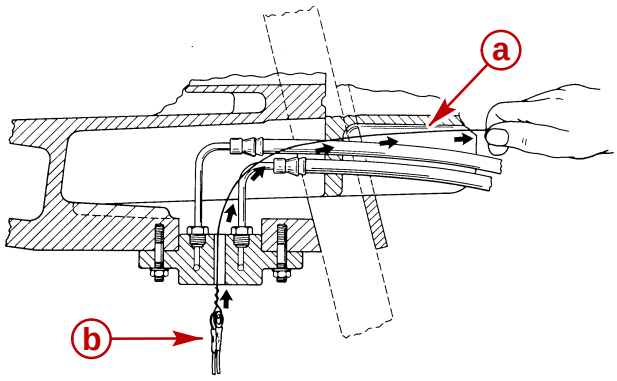
22235

a - Wire

6. Secure ring terminals to tracer wire.
7. Guide leads through center hole in connector block.

IMPORTANT: Orange lead is approximately 6 in. (150 mm) longer than the brown lead.

8. Pull leads ALL the way into the boat.



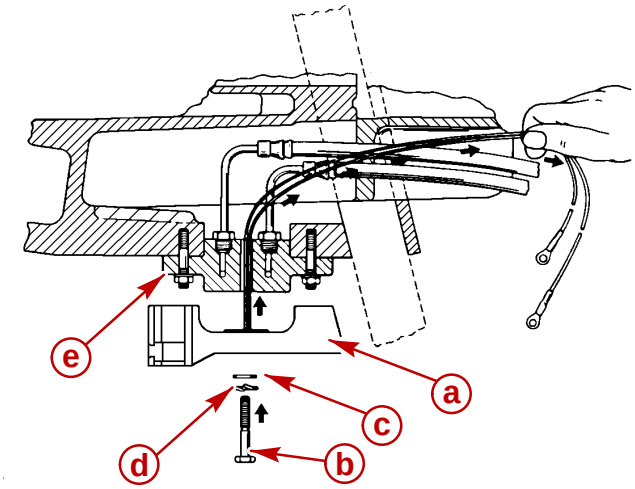
22234

a - Wire
b - Leads

⚠ CAUTION

DO NOT paint sacrificial anodes or MerCathode System electrode assembly, as this will render them ineffective as galvanic corrosion inhibitors.

9. Position and secure electrode assembly to gimbal housing using two 1-3/8 in. (35mm) long screws, flat washers and lockwashers. Torque to 25 lb-in. (2.8 Nm). DO NOT OVERTIGHTEN.



70771

a - Electrode Assembly
b - Screw (2)
c - Flat Washer (2)
d - Lock Washer (2)
e - Hydraulic Connector Block

Connect Electrical Leads to Controller Assembly

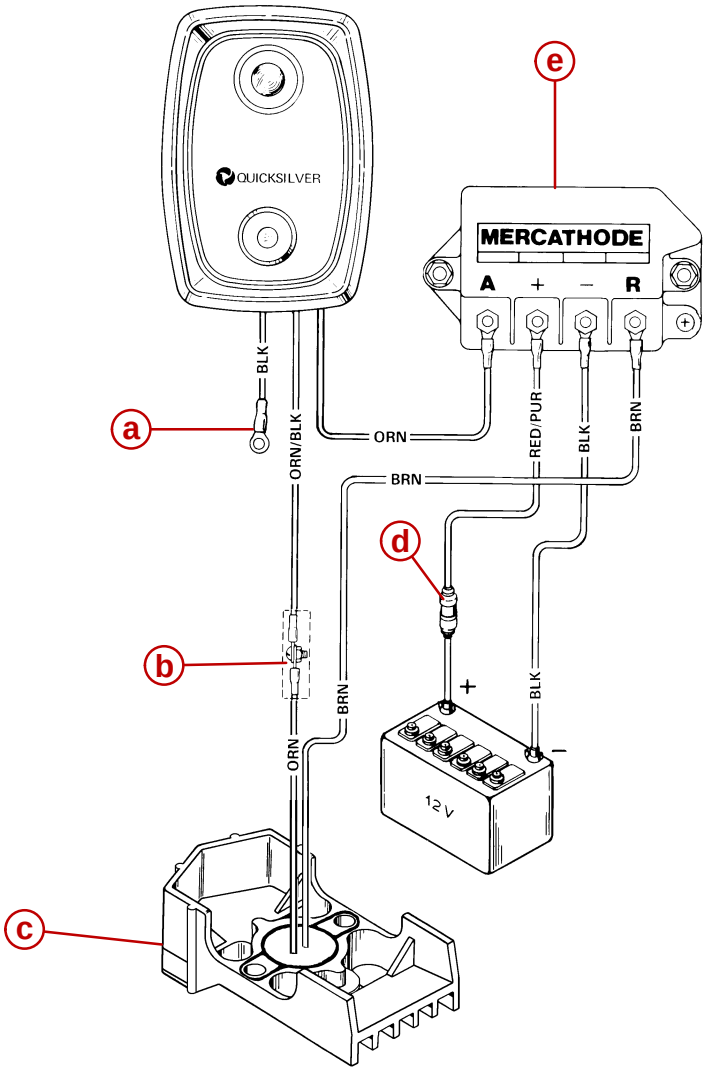
NOTE: *If black (ground) wire is not available at terminal block or from wire harness, install a separate lead between controller negative (–) terminal and negative (–) battery cable attaching point on engine.*

1. Connect electrical leads to controller assembly, securely. (See applicable Wiring Diagrams, following.)
2. Apply a thin coat of Quicksilver Liquid Neoprene (92-25711) to ALL electrical connections.

Wiring Diagrams

MerCathode Monitor

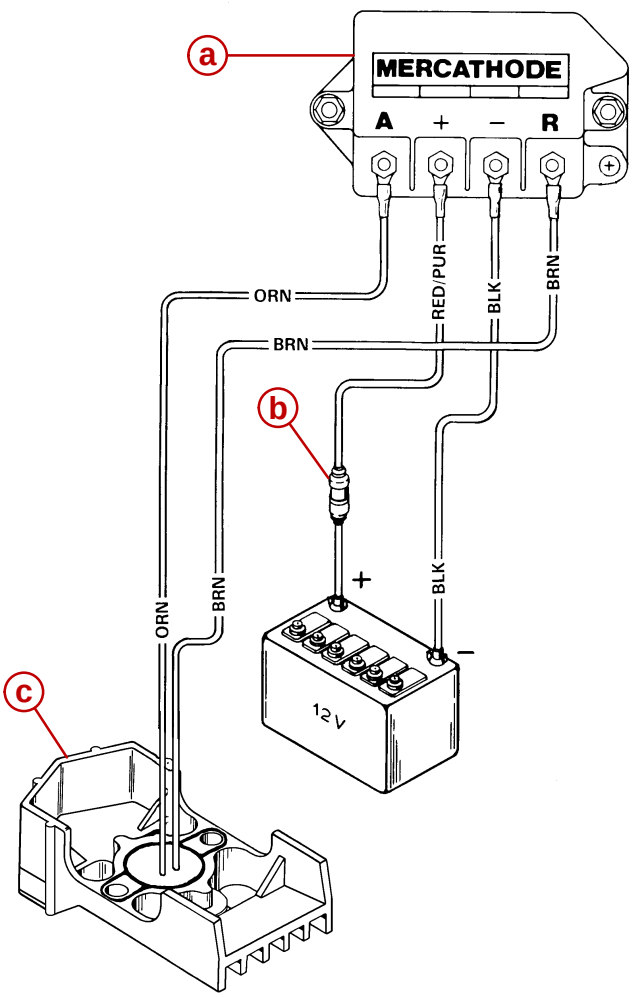
BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT= White
YEL = Yellow
LIT = Light
DRK = Dark



74251

a - Ground to a Suitable Ground on the Instrument Panel
b - Screw, Nut and Sleeve
c - Electrode
d - 20 Amp Fuse
e - Controller

MerCathode Controller



BLK = Black
BLU = Blue
BRN = Brown
GRY = Gray
GRN = Green
ORN = Orange
PNK = Pink
PUR = Purple
RED = Red
TAN = Tan
WHT = White
YEL = Yellow
LIT = Light
DRK = Dark

73596

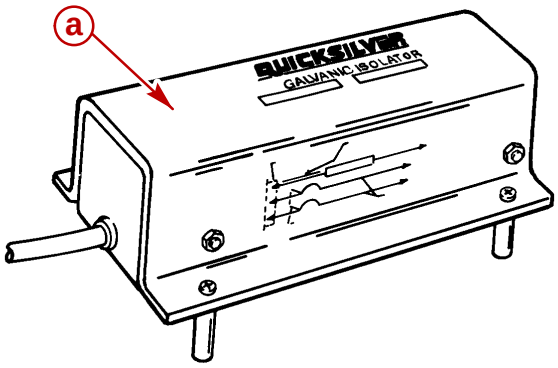
a - Controller
b - 20 Amp Fuse
c - Electrode

Quicksilver Isolator

Boats, which are connected to A.C. shore power require additional protection, to prevent destructive low voltage galvanic currents from passing thru the shore power ground wire. A Quicksilver Isolator (18478A2) can be installed to block the passage of these currents, while still providing a path to ground for dangerous fault (shock) currents.

⚠ CAUTION

If A.C. shore power is not isolated from boat ground, the MerCathode System and sacrificial anodes may be unable to handle the increased galvanic corrosion potential.



70972

a - Quicksilver Isolator

Corrosion Protection Testing and Troubleshooting

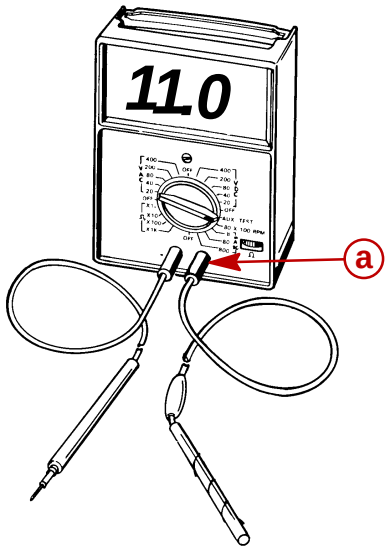
NOTE: *The following corrosion protection test supersedes all previously issued tests. This test can be used on applications with or without a MerCathode System.*

If the unit is equipped with a MerCathode System, this test should be performed annually where the boat is moored to ensure that the system is functioning properly.

Test requires the us of MerCathode Reference Electrode Test 76675A1 and Quicksilver VOA meter 91-62562A1. This meter is no longer available from Mercury Marine. If you do not already have this meter, a digital multi-meter must be used. A STANDARD ANALOG METER CANNOT BE USED, AS AN INACCURATE READING WILL RESULT.

IMPORTANT: Quicksilver Volt/Ohm Meter 91–93572 and Multi-Meter DVA/Tester 91-99750 are no longer recommended for testing corrosion protection.

The MerCathode Reference Electrode Tester 76675A1 is equipped with a special jack containing a resistor to provide the proper scale reading when used with a digital multimeter. **Do NOT remove this plug or use analog meters.** Resistor jack can be left in place when using digital meters.



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Digital Multimeter and MerCathode Reference Tester 76675A1

a - Special Resistor Jack

NOTE: *Set-up test equipment as shown on page 7A-21.*

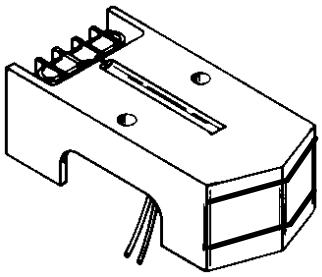
IMPORTANT: Be sure to observe the following when performing test:

- If equipped with MerCathode System, ensure battery is fully charged (12.6 Volts or above).
- Boats recently placed in service usually will produce a reading higher than normal because the sterndrive unit is protected by a good finish and new sacrificial anodes. To obtain an accurate diagnosis, the test should be performed after the boat has been in service at least one or two weeks. This will give the paint a chance to soak and minor abrasions and scratches will have appeared resulting in a more accurate reading.
- Boats should be moored, without being operated, for at least 8 hours before performing tests. This is necessary to allow the MerCathode System and/or sacrificial anodes to polarize the surrounding water. Be careful not to rock the boat excessively while boarding to perform a test as this will alter the test reading.

1. Plug negative meter lead into negative (–) receptacle of meter. Connect other end of lead to negative (–) battery terminal or other convenient engine ground.
2. Plug Reference Electrode Tester lead into positive (+) receptacle of meter.
3. Set meter on scale required to read 0-2000 millivolts (0-2 volts).

4. Immerse Electrode Tester in the water within 6 in. (150 mm) of aft end of sterndrive unit.

IMPORTANT: There will be different voltage readings depending on the type of Mer-Cathode System you are testing.



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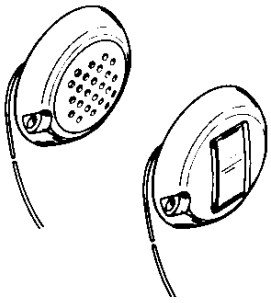
Electrode Mounted on Bottom of Transom Assembly



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Electrodes Mounted on Boat Transom

5. The following readings indicate that the sterndrive unit is adequately protected:

   a. **MODELS WITH ELECTRODE MOUNTED ON BOAT TRANSOM**

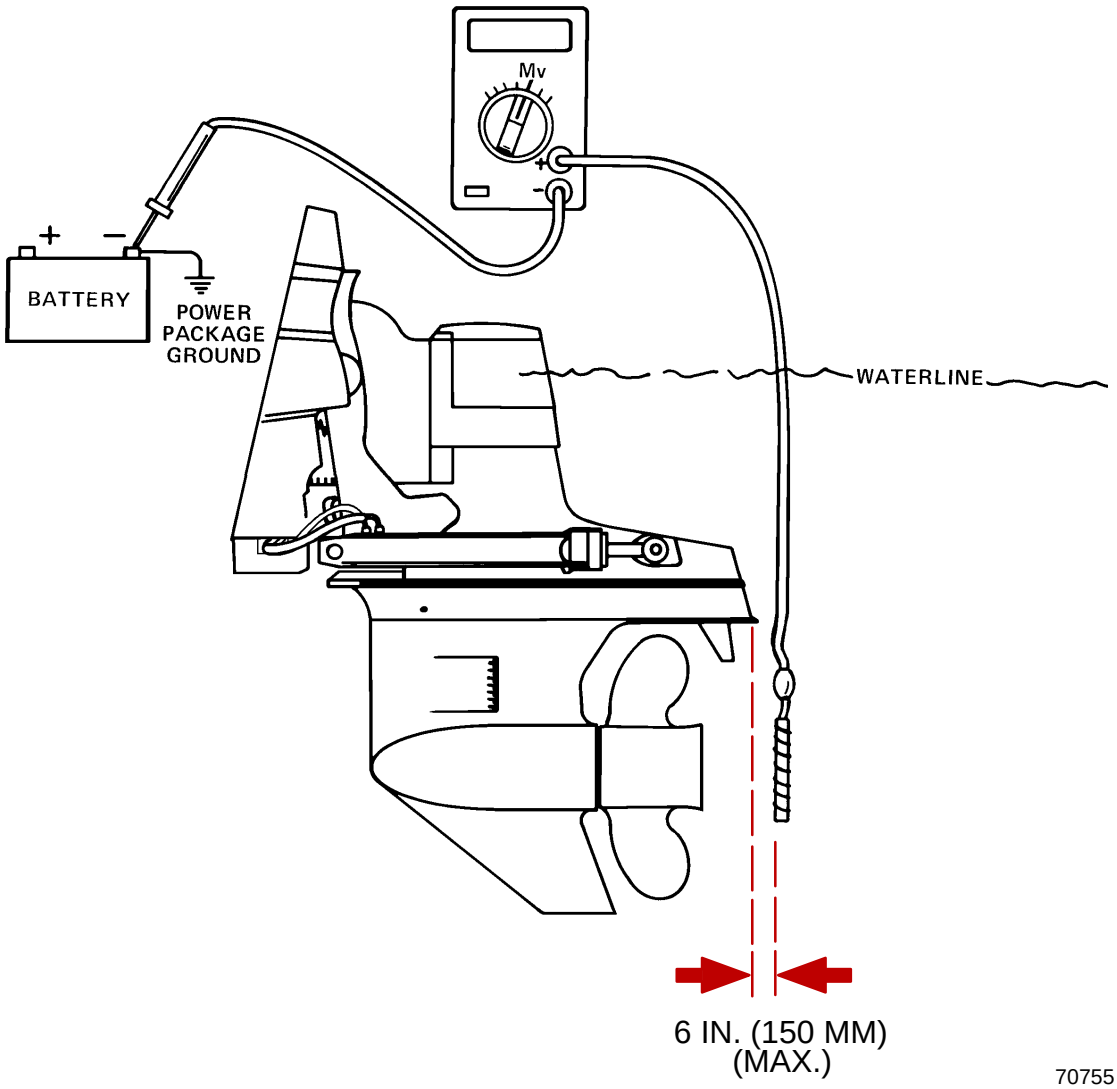
	Fresh Water Areas	Salt, Polluted or Mineral Laden Water Areas
Quicksilver VOA Meter	7.5 - 10.5 millivolts	8.8 - 10.5 millivolts
Digital Meter	750 - 1050 millivolts	880 - 1050 millivolts

   b. **MODELS WITH ELECTRODE MOUNTED ON BOTTOM OF TRANSOM ASSEMBLY**

	Fresh Water Areas	Salt, Polluted or Mineral Laden Water Areas
Quicksilver VOA Meter	6.2 - 11.8 millivolts	7.5 - 11.8 millivolts
Digital Meter	620 - 1180 millivolts	750 - 1180 millivolts

6. If the reading is not within specified limits, or if reading is within specifications but there is evidence of corrosion on sterndrive, refer to the following troubleshooting charts to aid in diagnosis.

Test Equipment Set-Up



Low Readings

Cause	Special Instructions
Loss of continuity between sterndrive unit components and negative (-) battery terminal.	Ensure that continuity devices are not missing or damaged and that connections are clean and tight.
Shore power green safety grounding lead not isolated from the power package ground on boats equipped with shore power.	Disconnect shore power and verify if reading increases. If so, install a Quicksilver Isolator P/N 18478A2 or an isolation transformer.
Underwater metal parts on the sterndrive unit and/or boat are unpainted or the paint is in poor condition. The boat has more exposed metal than the anodes and/or MerCathode system can protect.	Prime and paint underwater metal parts. This will reduce the load on the anodes and/or MerCathode system.
Anodes painted.	Remove paint or replace anodes.
The anodes are improperly grounded or inactive.	Clean anode mounting surface or replace anodes if they have oxidized.
Anodes consumed (no longer protect).	Replace anodes if eroded 50% or more.
Sterndrive unit and/or boat bottom painted with anti-fouling paint containing copper or tin.	Avoid any electrical interconnection between the MerCruiser product, anodic blocks, or MerCathode system and the paint by allowing a minimum of 1-1/2 in. (40 mm) of UNPAINTED area around these items on the transom of the boat.
MerCathode reference electrode or anode painted.	Remove paint.
Anodic heads used instead of plastic caps.	Reinstall the plastic caps.
No power to MerCathode controller.	Connect the positive (+) volt meter lead (set on 0-20 volt scale) to the positive (+) controller terminal and the negative (–) volt meter lead to the negative (–) terminal. The meter should indicate battery voltage. Check for a blown fuse (if equipped) on the starboard MerCathode system. Clean the connection or repair wiring as required.
Poor connection between reference electrode lead (brown) or anode lead (orange) and MerCathode controller.	Clean and/or tighten the connection. Repair the wiring.

Low Readings (continued)

Cause	Special Instructions
Faulty MerCathode reference electrode.	Disconnect the reference electrode lead(brown) from the controller “R” terminal. Connect the lead to the positive (+) terminal of a digital multimeter (set on 0-2000 millivolt scale). Connect the negative (–) meter lead to the negative (–) battery terminal. Note the meter reading; then repeat the test using a MerCathode Reference Electrode Tester 76675A1. You should obtain the same reading in both cases. If not, replace the reference electrode.
Faulty MerCathode Controller.	With anode and reference electrode leads connected to the controller, connect the jumper wire between “R” and negative (-) terminals on the controller. Connect the positive (+) lead of the volt meter (set on 0-20 scale) to terminal “A” on the controller. Connect the negative (-) meter lead to the negative (-) controller terminal. Reading should be as follows: ● **Freshwater Areas -** Electrodes Mounted on boat transom: 7.5 - 10.5 Millivolts Electrode mounted on bottom transom assembly: 6.2 - 11.8 Millivolts ● **Saltwater Areas -** Electrodes mounted on boat transom: 8.8 - 10.5 Millivolts Electrode mounted on bottom of transom assembly: 7.5 - 11.8 Millivolts If the reading is low, replace the controller.
Additional corrosion protection required. Boats equipped with a sizable amount of underwater metal (stainless steel prop, after planes, etc.), or that are moored in an area with warm or rapid flowing water may require additional protection.	Install additional anodes or MerCathode system 88334A2. If the unit is already equipped with a MerCathode system, a second system may be required.

High Reading

Cause	Special Instructions
Stray current corrosion. If an electrical current flowing along a metal conductor leaves the metal for a water path, it will cause ionization of the metal, and an area of rapid corrosion.	Observe the reading while disconnecting the electrical components one at a time until you eliminate the high reading. Correct the course of stray current.
Poor connection between MerCathode reference electrode lead (brown) and “R” terminal on controller.	Clean and /or tighten connection. Repair wiring as required.
Faulty MerCathode reference electrode.	Disconnect the reference electrode lead (brown) from “R” terminal on the controller. Connect the lead to the positive (+) terminal of a digital multi-meter (set on 0-2000 millivolt scale). Connect the negative (–) meter lead to the negative (–) battery terminal. Note the meter reading; then, repeat the test using MerCathode Reference Electrode Tester 76675A1. Both tools should produce the same reading. If not, replace the reference electrode.
Faulty MerCathode controller.	Replace the controller.

Normal Reading But Corrosion is Evident

CORROSION ON THE ENTIRE STERNDRIVE UNIT

Cause	Special Instructions
The sterndrive unit is raised so that the sacrificial anodic trim tab is out of the water.	Leave the sterndrive unit in the IN/DOWN position when the boat is moored to ensure the trim tab is in the water, providing protection.

CORROSION PROBLEM DEVELOPED AFTER REFINISHING THE DRIVE UNIT

Cause	Special Instructions
A steel wire brush was used to clean the aluminum casting. Steel particles became en-trapped and set up a small galvanic cell.	Use only a nylon or bristle brush.

PAINT BLISTERING ON DRIVE UNIT

Cause	Special Instructions
Battery charger, using 110 volt shore power improperly connected to the battery.	Ensure the charger is connected correctly.

TRIM CYLINDER CORRODING

Cause	Special Instructions
Continuity lost between trim cylinder and drive unit.	Install proper continuity devices.

ONLY ONE OR TWO COMPONENTS CORRODING

Cause	Special Instructions
Continuity lost between drive unit and components.	If not already done, install Continuity Circuit Kit 99940A1.

CORROSION IN THE EXHAUST OUTLET AREA

Cause	Special Instructions
Exhaust gas deposits accumulating on the drive exterior can result in paint blistering and corrosion.	Remove deposits with marine or automotive wax.

CORROSION OCCURS AFTER THE UNIT IS REMOVED FROM THE WATER

Cause	Special Instructions
Salt crystals remaining on the surface of the drive components combine with high humidity to cause electrolyte formation, resulting in corrosion.	Wash drive exterior and flush drive interior with fresh water.

CORROSION BETWEEN SURFACES

Cause	Special Instructions
Salt buildup between surfaces.	Protect mating parts with Quicksilver Special Lubricant 101, Perfect Seal or Quicksilver 2-4-C Marine Lubricant.

ALUMINUM CORRODING IN LUBRICATED AREAS

Cause	Special Instructions
Graphite in the lubricant.	Never use lubricants containing graphite because they accelerate corrosion. Use specially formulated Quicksilver marine lubricants.

STAINLESS STEEL COMPONENTS CORRODING

Cause	Special Instructions
Foreign matter (fishing line, marine growth, etc.) covering the steel and starving it of oxygen. This causes a breakdown of the protective oxide film and subsequent corrosion (known as oxygen starvation corrosion). Burying stainless steel in sand or silt can also cause this problem.	Remove foreign matter and prevent surfaces from being covered by sand or silt.

STAINLESS STEEL PROPELLER CORRODING

Cause	Special Instructions
Continuity lost between propeller and propeller shaft.	Clean the mating surfaces on the propeller, propeller shaft and attaching parts. If applicable, install a continuity washer.

PAINT BLISTERING - THE METAL UNDER THE BLISTERED PAINT IS NOT PITTED

Cause	Special Instructions
The surface was not properly prepared before paint was applied.	Sand the surface down to bare metal, prime and repaint with Quicksilver Spray Paint.

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